

FORAMINIFERA COLLECTED NEAR THE HAWAIIAN ISLANDS BY THE STEAMER ALBATROSS IN 1902.

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While the examination of this material was in progress, after about 100 species of Foraminifera had been identified and described, almost the entire collection was destroyed by fire and the original scale of the report thus had to be abandoned. It is possible to give only a summary of the results derived from a study of the material saved from the fire, which consists of 19 bottles containing chiefly typical *Globigerina* and *Pulvinulina* ooze. The species, over 200 in number, represent 54 genera and are mostly characteristic of warm waters in tropical oceans.

The following method was used in the examination of the material: On a fine-grained cloth of double thickness in a long porcelain tray were poured the contents of each vial. Additional alcohol was used to thoroughly wash this ooze, and the Foraminifera were spread out on the cloth, which was then lifted out and dried over a lamp. The shells were easily shaken from the dried cloth, not dried together in lumps, and a soft brush removed from the cloth the very finest portion of the ooze that might be left after shaking. The forms thus selected were clean and white and could be spread out on black cardboard for microscopic examination. The remainder of the alcoholic solution, with the finest mud and ooze, was allowed to settle in the tray, and, with the label, was returned to the bottle from which it had been taken. With this method any radiolaria or diatoms that may have been present were left in the solution and can be further studied. The mechanical sediment likewise was saved, and the fragments of any other organisms that might be present. It was found best to examine most of the material in reflected light, and the tests were most readily studied upon a black background, for which purpose I used thick glossy cardboard which had been glued to a glass slide.

The mounting and extraction of Foraminifera can be accomplished in many ways. An excellent description of such work is to be found in Chapman's *The Foraminifera* (chap. xix, pp. 291-326). It is, however, rather expensive and tedious to mount on separate cover under glass every species recognized, and I therefore used the following method: The specimen to be preserved was fastened with strong glue upon a slip of heavy white paper which had been blackened with india ink where the specimen was to be mounted. On this slip of paper was put also the number and description of the dredging station and the name of the species mounted. Two specimens upon different surfaces are generally all that is required for future use, although it is desirable to have a side aspect of the test, and this requires some skill to keep the form in place until it is permanently fixed. If in future these forms are wanted for other purposes they can readily be detached by strong vinegar and washed quickly in alcohol and water. A wet brush enables one to pick up the tiny shells with considerable rapidity and to hold them in any desired position while studying them.

Only brief descriptions of species have been given in most instances in this report, but new forms and also some of the more important known types have been discussed quite fully. The new forms are bottled separately and marked "Type," and have been deposited in the U. S. National Museum. While I have not separately mounted from every bottle of dredgings each species as it repeatedly occurred, every form identified has been selected and mounted by the method described, and in many instances a single form has been prepared again and again as particularly instructive and characteristic. In the arrangement of the classification of species given in this paper we have followed the order adopted by the British authorities on the Rhizopoda, W. K. Parker, T. R. Jones, W. B. Carpenter, and amended by H. B. Brady and the later writers, C. D. Sherborn and Frederick Chapman.

The first reference of each form listed is that of the original description of the species. Much valuable information has been obtained from the exhaustive monographs by Prof. H. B. Brady in the *Challenger Report*, and by Dr. Alexander Goes on Arctic and Scandinavian recent marine Foraminifera^a, and the excellent report on recent Foraminifera by Dr. James M. Flint^b. Mention should be made also of such invaluable works as Williamson's *Recent Foraminifera of Great Britain* (Ray Society, 1858); Brady, Parker, and Jones on some Foraminifera from Abrohos Bank (1888) Chapman's *The*

^a Kongl. Svensk. Vetenskaps-Akademiens Handlingar, XXV, No. 9, Stockholm, 1894.

^b Report of the U. S. National Museum for 1897.

Foraminifera (1902); and d'Orbigny's Foraminifera of the Vienna Basin (1846), which have been found indispensable.

There are some anomalies concerning the bathymetric range of a number of species mentioned in this report. The occurrence of few deep-water types in those stations beyond 1,000 fathoms is not easily accounted for, but it must be remembered that many of these Foraminifera are of almost universal distribution, and some that are recognized and described are not at all common or abundant and would not be considered as determining the probable depth of the ocean from whence they came. Systematists on the Foraminifera can not be too careful on this point. It is well known that the temperature of the great oceans is fairly constant below a few hundred fathoms, and the distribution of life is on the whole quite largely dependent upon the distribution of the food supply as well as upon temperature of the water in which these organisms live. Then again some forms are pelagic in habit and can easily be found after death in bottom material in an occasional specimen. It is but proper to state that we have considerable evidence of rather shallow water, say not over 500 fathoms, in the material studied, while the facts show that a number of the stations are considerably over 1,000 fathoms in depth. Those species which reach their maximum development and are most abundant in each station determine more safely the relative depth than do any occasional specimens obtained from the same locality. Bryozoa, Mollusca, both lamellibranchs and gastropods, are found in a number of bottles, also fragments of shells from stations below 200 fathoms, and this is rather hard to explain unless they have been carried outward by tidal or other ocean currents in rapid motion.

The greatest variety of forms was obtained at Station 4694, from which 62 species were determined. The smallest number (4) came from Station 4579, where the material was chiefly mechanical sediment. Mollusca were present in some of the dredgings, particularly tiny gastropods, with an occasional lamellibranch, often very beautifully colored. Ostracoda of several genera were quite prominent. Diatoms and radiolarians in a few instances were met with, also fragments of corals and bryozoans. In a few bottles small mouth plates of fishes were present. There were a large number of sponge spicules (siliceous), and in some bottles fragments of volcanic glass and land-derived sand grains with opalescent quartz. Phosphatic nodules which dissolve very readily in acids appear in some localities.

Most of the Foraminifera in this collection belong to calcareous types with perforate tests, but the Miliolidae are well represented in some stations. The species *Candeiina nitida*, *Globigerina aquilateralis*, *Globigerina bulloides*, *Orbulina universa*, *Pulvinulina menardii*, and *Pulvinulina micheliniana* are present in nearly every station's

dredgings. The genus *Bolivina* is represented by many species and they are abundant in nearly all instances. The genera *Bigenerina*, *Bolivina*, *Pulvinulina*, *Sagraina*, *Uvigerina*, and *Virgulina* have each a new species.

Stations represented in Foraminifera collections.

[D. = Dredging station; H. = Hydrographic station.]

Albatross station number.	Depth in fathoms.	No. of species.	Remarks.
D. 4000...	104-213	55	Coarse concretionary shell material.
D. 4017...	305	47	Fine foraminiferal ooze.
D. 4025...	275-368	41	Fine Globigerina ooze, Pulvinulina of <i>menardii</i> type, not abundant.
D. 4174...	735-865	45	Typical Globigerina ooze.
H. 4430...	1,544	17	<i>P. menardii</i> abundant and typical.
H. 4440...	1,259	31	Diatoms present, fine silt and ooze.
H. 4476...	438	25	Very coarse shell material, Globigerinae few, Amphistegina abundant.
H. 4502...	1,342	36	Gray Globigerina ooze, <i>G. rubra</i> very abundant.
H. 4508...	495	52	Phosphatic nodules, Uvigerinae common.
H. 4555...	1,398	41	Brown fine silt. <i>P. menardii</i> abundant.
H. 4566...	572	58	Typical Globigerina ooze. Pulvinulina abundant and beautiful.
H. 4567...	1,307	51	Pulvinulinae abundant.
H. 4568...	1,274	41	Diatoms; Pulvinulinae not abundant.
H. 4571...	384	41	Gray Globigerina ooze. <i>G. sacculifera</i> very abundant.
H. 4579...	387	4	A few gastropods and small shells.
H. 4585...	689	40	<i>G. conglobata</i> abundant. Considerable black sand present.
H. 4590...	978	28	Fine silty ooze.
H. 4694...	865	62	Typical Globigerina ooze.
H. 4686...	367	47	Cristellariae abundant.

Illustrations of the new species described are shown on Plate V, which will be found at the end of the paper.

DESCRIPTIVE LIST.

Family MILIOLIDÆ.

Subfamily NUBECULARIINÆ.

Genus NUBECULARIA.

NUBECULARIA INFLATA Brady.

Nubecularia inflata BRADY, Chal. Rept., IX, 1884, p. 135, pl. 4, figs. 5-8.

"Test consisting of a few misshapen, inflated segments, irregularly combined; aperture either single and simple, or more usually consisting of a number of rounded orifices variously placed."^a

What appears to be identical with the form above described was found at Station D. 4000.^b The *Challenger* specimens were from the Honolulu coral reefs, 40 fathoms, and various islands to the south and west.

^a Brady, Chal. Report, IX, p. 135.

^b All stations cited in this paper are those of the Bureau of Fisheries steamer *Albatross* unless otherwise mentioned.

Subfamily MIIOLIANINAE.

Genus BILOCULINA.

BILOCULINA BULLOIDES d'Orbigny.

Biloculina bulloides D'ORBIGNY, Ann. Sci. Nat., VII, No. 1, 1826, p. 297, pl. XVI, figs. 1-4.

Thick-shelled globose test with highly inflated segments and circular aperture. The species belong to moderate depths and has been obtained in all the great oceans rather sparingly, but is more common in the North Atlantic.

Occurs as stated above, and is best developed at depths ranging from 300 to about 1,000 fathoms. In the neighborhood of the New Guinea Islands this foraminifer has been obtained in very shoal waters. It is present at *Albatross* Stations D. 4000, D. 4025, H. 4555, and H. 4696.

BILOCULINA COMATA Brady.

Biloculina comata BRADY, Quart. Journ. Microsc. Sci., XXI, n. s., 1881, p. 45.

Similar to *Biloculina bulloides*, but with the surface covered by longitudinal striations, and the shell of large dimensions. Found with other biloculine forms in the North Atlantic and the Pacific oceans. Rare in the dredgings we have studied. Present only at Station D. 4000.

BILOCULINA DEPRESSA d'Orbigny.

Biloculina depressa D'ORBIGNY, Ann. Sci. Nat., VII, No. 7, 1826, p. 298, modele No. 91.

Margin thin and angular, shell depressed as the name implies. The form is closely related to *Biloculina ringens*, but the latter has less sharply defined margin and a different aperture.

If the foraminifers described and figured by Terquem and Berthelin from the Lias of Essey-les-Nancy under the name *Biloculina liasica* are identical with the present form the species occurs much earlier geologically than any of its congenitors. Its recent distribution is similar to that of *Biloculina bulloides* given above. It was found at Stations D. 4000, D. 4174, H. 4430, H. 4502, H. 4566, H. 4567, H. 4568, H. 4585, and H. 4590.

BILOCULINA DEPRESSA var. MURRHYNIA Schwager.

Biloculina murrhyna SCHWAGER, Novara-Exped., Geol. Theil, II, 1866, p. 203, pl. VI, figs. 15 a-c.

A variety of *Biloculina depressa* characterized by two angular spinous projections near the base of the test and placed symmetrically apart from the median line.

This variety would appear to be rare, judging from the *Challenger* investigations, as Professor Brady mentions but four localities, two each from the North and South Atlantic and Pacific oceans. Dr. C. Schwager's specimens came from the Pliocene of Nicobar Islands. This form was found at Station H. 4502, and was abundant at Station H. 4555.

BILOCULINA IRREGULARIS d'Orbigny.

Biloculina irregularis D'ORBIGNY, *Foram. Amer. Merid.*, 1839, p. 67, pl. VIII, figs. 22-24.

This species does not reveal the characteristic biloculine habit of growth in its adult stage, but the test is globose and there are two major segments in the final development which are similar to *Biloculina bulloides* in their shape and position. The asymmetry appears from the third segment, cutting one side obliquely like *Poly-morphina* types and appearing as a faint line on the outer surface of the shell neither depressed nor elevated.

Biloculina ventricosa Reuss, is the same as this species, which can be distinguished from *Biloculina sphaera* by its milioline aperture and the extension of the ultimate chamber.

The *Challenger* dredged this foraminifer from the neighborhood of the Canaries in 1,125 fathoms; off Sombrero Island, 450 fathoms; south of Pernambuco, 350 fathoms, and in mid-ocean in the South Atlantic from 1,415 fathoms. It was also obtained near the Fiji, Tahiti, and Papua islands at depths of 610, 620, and 1,070 fathoms, respectively. The *Albatross* found it only at Station 4696, where it was rare.

The Septaria clays of Hermsdorf near Berlin and the salt beds of Wieliczka have furnished the species among other fossil Foraminifera.

BILOCULINA ELONGATA d'Orbigny.

Biloculina elongata D'ORBIGNY, *Ann. Sci. Nat.*, VII, No. 4, 1826, p. 298.

Test resembling *Biloculina ringens* in outline and aperture but longer and much narrower, as the name implies. The species appears to be the equivalent of *Biloculina bougainvillei* and *B. patagonica* of d'Orbigny. The shell shows considerable variation, chiefly in amount of elongation and globosity.

Unlimited in distribution and depth, but most abundant in the South Pacific. Specimens were obtained at Stations D. 4017, D. 4025, and H. 4567.

Genus SPIROLOCULINA.

SPIROLOCULINA ACUTIMARGO Brady.

Spiroloculina acutimargo BRADY, Chal. Rept., IX, 1884, p. 154, pl. x, fig. 12-15.

The carinate peripheral margin of this thin complanate foraminifer is its chief characteristic. It has been obtained at Bermuda, 435 fathoms, four stations in the South Atlantic, 350 to 1425 fathoms, and three localities in the South Pacific, 15 to 255 fathoms, and also in shore sands of Madagascar. Present rarely at Stations D. 4174, D. 4025, and H. 4694.

SPIROLOCULINA GRATA Terquem.

Spiroloculina grata TERQUEM, Mem. Soc. geol. France, ser. 3, I, 1878, p. 55, pl. x, figs. 14, 15.

A thin complanate *Spiroloculina* with striate surface and common in coral reef material down to 400 or 500 fathoms. First described in the Tertiary of the island of Rhodes. Occurs at Stations D. 4017, H. 4567, and H. 4694.

SPIROLOCULINA LIMBATA d'Orbigny.

Spiroloculina limbata D'ORBIGNY, Ann. Sci. Nat., VII, No. 12, 1826, p. 299.

Common in shallow water and found down to 400 fathoms in tropical and subtropical oceans. Known also from the Septaria Clay of Germany and in the later formations of Italy and Sicily. Found at Station D. 4017 only; depth, 305 fathoms.

SPIROLOCULINA NITIDA d'Orbigny.

Spiroloculina nitida D'ORBIGNY, Ann. Sci. Nat., VII, No. 4, 1826, p. 298.

Common in coral tropical sands and in the inland Japan and Mediterranean seas. Found at Station D. 4017 only; depth, 305 fathoms.

SPIROLOCULINA PLANULATA (Lamarck).

Miliolites planulata LAMARCK, Ann. du Museum, V, No. 4, 1805, p. 352; Anim. Sans Vert., VII, No. 4, 1822, p. 613.

With the exception of two soundings mentioned by Parker and Jones, this species is limited to shoal waters in temperate and subtropical oceans. It is rather common also in coral shoal water sands in the Pacific and Indian oceans and Red Sea. Found at Stations D. 4025, H. 4508, and H. 4694.

SPIROLOCULINA TENUIS (Czjzek).

Quinqueloculina tenuis CZJZEK, Haidinger's Nat. Abhandl., II, 1847, p. 149, pl. XIII, figs. 31-34.

Inhabiting all great oceans. Abundant in the South Pacific but less common in the North Pacific, and known from depths of a few fathoms down to 2,750. Professor Brady writes that the finest specimens come from moderate depths. Fossil in the Austrian Tertiary. Occurs at Stations D. 4000, D. 4017, H. 4440, H. 4571, H. 4590, and H. 4696.

Genus MILIOLINA.

MILIOLINA BICORNIS var. ELEGANS Williamson.

Miliolina bicornis var. *elegans* WILLIAMSON, Recent Foram. Gt. Britain, 1858, p. 88, pl. VII, fig. 195.

Differs from the type *M. bicornis* in the regular symmetry of its chambers and in the uniform size and regular parallelism of the surface grooves.

This striate form is rarely found at depths greater than 50 fathoms. The method of growth as shown by Schlumberger is in accord with that of d'Orbigny's genus *Adelosina*, in which the megasphere is completely enveloped by the first chamber, which becomes lenticular. It then passes through the biloculine, milioline, triloculine, quadriloculine, and quinqueloculine stages. Our form very closely represents this quinqueloculine form and the aperture is in the end on a considerably lengthened tube. Unfortunately we have but one broken specimen of this interesting species.

Miliolina bicornis is fossil in the London clay and the Paris Basin Eocene.

MILIOLINA CUVIERIANA (d'Orbigny).

Quinqueloculina cuvieriana D'ORBIGNY, Foram. Cuba, 1839, p. 164, pl. XI, figs. 19-21.

Test consisting of five segments with sharp or subcarinate margins and smooth unornamented surface. It is the same as *Q. lamareckiana* figured on the same plate (figs. 14, 15). A shallow tropical water species particularly known around the region of Japan, the Philippines, and the islands of the Eastern Archipelago. While it is one of the most common Miliolinæ in the *Albatross* material, the number of specimens in each locality is small. Found at Stations D. 4000, D. 4017, D. 4025, H. 4555, H. 4590, and H. 4694.

MILIOLINA LINNÆANA (d'Orbigny).

Triloculina linnaana D'ORBIGNY, Foram. Cuba, 1839, p. 153, pl. IX, figs. 11-13.

"Under the name *Triloculina linnaana*, d'Orbigny depicts^a a modification or variety of *Miliolina pulchella*, which takes the place to a great extent of the typical form in tropical seas. It differs from *Miliolina pulchella* in its comparatively thin and outspread contour, which sometimes approaches that of *Spiroloculina*, the costæ being few, thick, and well marked. A nearly identical form is described in the Vienna Basin memoir with the name *Quinqueloculina josephina*."^b Limited to shallow tropical waters. Occurs at Stations D. 4174 and H. 4568.

MILIOLINA OBLONGA (Montagu).

Vermiculum oblonga MONTAGU, Test. Britain, 1803, p. 522, pl. XIV, fig. 9.

A cosmopolitan species known from all areas and depths, but best developed in shallow temperate seas. Found at Station D. 4000 only.

MILIOLINA PARKERI Brady.

Miliolina parkeri BRADY, Quart. Journ. Microsc. Sci., XXI, n. s., 1881, p. 46.

Surface of the segments crenulated and sharply angled at their margins.

With the exception of forms from the Red Sea this species is a coral reef form in the tropical region of the Pacific Ocean. Occurs at Stations D. 4000, H. 4566, and H. 4694.

MILIOLINA SEPARANS Brady.

Miliolina separans BRADY, Quart. Journ. Microsc. Sci., XXI, n. s., 1881, p. 45.

An anomalous wild-growing form like *Quinqueloculina linnaana* partly unrolled. Limited to very shallow water of the tropical Pacific. Found at Station D. 4174 only.

MILIOLINA SEMINULUM (Linnæus).

Serpula seminulum LINNÆUS, Syst. Nat., 12th ed., 1767, p. 1264; 13th (Gmelin's) ed., 1788, p. 3739.

^a Foram. Cuba, 1839, p. 153.

^b Brady, Chal. Rept., IX, p. 174.

MILIOLINA SEMINULUM var. DISCIFORMIS Williamson.

Miliolina seminulum var. *disciformis* WILLIAMSON, Recent Foram. Gt. Britain, 1858, p. 86, pl. vii, figs. 188, 189.

Resembling the typical form but more complanate and with broader, shorter segments, frequently emarginate at their umbilical borders and possessing transverse ridges of growth which are lacking in the typical species. Common along the English coast in shell sand. Occurs in every latitude and is known from all depths. Geologically its history dates from the early Eocene. Not very common, but present at Stations D. 4017 and H. 4694.

MILIOLINA TRICARINATA (d'Orbigny).

Triloculina tricarinata D'ORBIGNY, Ann. Sci. Nat., VII, 1826, p. 290, No. 7, modele, No. 94.

Tricarinate miliolina are not at all rare, but this species is more widely distributed than its related form *M. trigonula*. The carinate feature is in *M. tricarinata* limited to the peripheral portion, the intervening portion being more or less gibbous, but the species is subject to great variation and is perhaps easily confused with *Miliolina trigonula*. While having an almost unlimited geographical distribution the species is also of great bathymetric range and is known from a few fathoms down to 2,350 fathoms. As a fossil, it is recorded from the early Tertiary. Found at Stations D. 4000, D. 4025, D. 4174, and H. 4694.

MILIOLINA TRIGONULA (Lamarck).

Miliolites trigonula LAMARCK, Ann. du Museum, V, No. 3, 1804, p. 351; Anim. sans Vert., VII, No. 2, 1822, p. 612.

Test regular triloculine, with smooth subspherical or elongate chambers and nearly circular end view. Distinguished from *M. tricarinata* by a difference in the roundness or angularity of the chambers. Of wide distribution in shoal waters, and more frequent in the temperate than in tropical regions. Absent in cold northern waters; found chiefly in temperate in-shore sands. Beyond 100 fathoms the form is said to be replaced by *Miliolina tricarinata*. Geological history, Tertiary to recent. Found at Stations D. 4000, D. 4017, D. 4025, H. 4568, and H. 4696.

Subfamily HAUBERLININÆ.

Genus VERTEBRALINA.

VERTEBRALINA INSIGNIS Brady.

Vertebralina insignis BRADY, Chal. Rept., IX, 1884, p. 187, pl. XII, figs. 9-11.

This rare species is known from off the Friendly Islands, 18 fathoms, in Torres Strait, 155 fathoms, and off the West Indies, 390 fathoms. Occurs at Station H. 4694 at a depth of 865 fathoms, which is its deepest recorded occurrence.

Subfamily PENEROPLIDINÆ.

Genus CORNUSPIRA.

CORNUSPIRA FOLIACEA (Philippi).

Orbis foliaceus PHILIPPI, Enum. Moll. Sicil., II, 1844, p. 147, pl. XXIV, fig. 26.

Test planospiral, with thin, flat, rapidly widening whorls, and while the surface has no decoration there are frequently curved transverse lines of growth as in many of the Gasteropoda. An allied form with carinate margin is *Cornuspira carinata* (Costa).

Rare in Scandinavian waters and Greenland (Goes), not uncommon in the Pacific, and ranging from shallow depths down to about 1,500 fathoms. Professor Brady states that the best specimens come from depths between 300 and 600 fathoms.

Present in the Eocene and later Tertiary. Recognized at Station D. 4017 only, but is not common.

CORNUSPIRA INVOLVENS Reuss.

Cornuspira involvens REUSS, Sitzungb. Akad. Wiss. Wien, XLVIII, 1863 (1864), Pt. 1, p. 39, pl. I, fig. 2.

Recognized by its rounded tubular whorls, which closely embrace each other and yet allow each whorl to be seen on either surface.

Geological history from Tertiary to recent. Has probably been confused with Jurassic and Cretaceous Ammodisci, which it resembles. Dr. A. Goes records the form in the Arctic and Norwegian waters at depths ranging from 30 to 180 meters. A shallow water cosmopolitan species. Observed at Stations D. 4017 and D. 4174.

Genus PENEROPLIS.

PENEROPLIS PERTUSUS (Forsk.)

Nautilus pertusus FORSKAL, Descr. Anim., 1775, No. 65, p. 125.

The genus *Peneroplis*, like *Orbiculina*, represents great variety of form and degree of compression and elongation of chambers without altering the segment arrangement or method of growth. For this reason and because of the transitional forms, it becomes necessary to separate the genus into several distinct types around which must

cluster the larger varieties of the type. The test of the genus *Peneroplis* is a planospiral, crozier-shaped, imperforate calcareous (porcellaneous) shell, and bilaterally symmetrical. An elaborate treatment of the genus is given by Dr. W. B. Carpenter in the Introduction to the Study of the Foraminifera (pp. 84-92, pl. vii). The surface of the shell is beautifully marked by transverse striae closely set and covering the entire surface, as a rule, but there are also occasional pits in the shell substance which resemble pores, though the shell is nevertheless imperforate. The genus can be well subdivided into the following types:

A. *Peneroplis pertusus* (Forskål). Nautiloid moderately compressed, involute shell with dendritic aperture.

B. *Peneroplis planatus* (Fichtel and Moll). Broad complanate forms, striated surface and with a single row of pores on the septal face.

C. *Peneroplis arietinus* (Batsch). Chambers at first involute, later nodosarian and numerous. Aperture a series of pores on the compressed anterior margin.

D. *Peneroplis cylindraceus* (Lamarek). Test less compressed than in *P. arietinus* and more nearly nodosarian.

E. *Peneroplis lituus* (Gmelin). Chambers few, cylindrical, nodosarian, but slightly irregular and of uneven size.

F. *Peneroplis carinatus* d'Orbigny. Near variety *P. pertusus* but more involute and with sharp periphery and less decorated surface.

G. *Peneroplis lavigatus*. Karrer. This is the most compressed type, somewhat resembling *Operculina adunca*, and the latter whorls embrace nearly two-thirds of the shell.

I find two types of the above genus, *P. pertusus* and *P. planatus*, the former occurring at Station 4017, the latter at Station 4694.

PENEROPLIS PERTUSUS var. PLANATUS (Fichtel and Moll).

Nautilus planatus FICHTEL and MOLL, Test. Microsc., 1803, p. 91, pl. xvi, figs. 1 d, e, f.

Found only at Station H. 4694 and is rare. The genus is usually found at less than 30 fathoms. Tropical and subtropical waters at many localities. Its geological history dates from the lower Tertiary (Eocene of Paris Basin, etc.).

Genus ORBICULINA.

ORBICULINA ADUNCA (Fichtel and Moll).

Nautilus orbiculus FICHTEL and MOLL, Test. Microsc., 1803, p. 112, pl. xxi.

A tropical species usually in shoal waters. Its earliest appearance is in the early Tertiary. Found at Stations D. 4000 and H. 4694.

Genus ORBITOLITES.

ORBITOLITES COMPLANATA Lamarck.

Orbitolites complanata LAMARCK, Syst. Anim. sans Vert., 1801, p. 376.

An inhabitant of shallow tropical waters, occasionally so abundant that it becomes an important factor in the building of tropical coral islands. Occurs rather sparingly at Stations D. 4000, H. 4476, and H. 4566.

ORBITOLITES MARGINALIS (Lamarck).

Orbulites marginalis LAMARCK, Anim. sans Vert., H. No. 1, 1816, p. 196.

Not quite so widely diffused as the species *Orbitolites complanata*, it is extensively found in warmer seas, and it is said by Doctor Carpenter to be more abundant where *Orbiculina* is rare, and the opposite. It obtained its maximum development in the early Tertiary, where specimens of enormous size and abundance are found. Not very common, but present at Stations D. 4000, H. 4476, and H. 4694.

Family ASTORRHIZIDÆ.

Subfamily RHABDAMMININÆ.

Genus RHABDAMNINA.

RHABDAMMINA DISCRETA Brady.

Rhabdammina discreta BRADY, Quart. Journ. Microsc. Sci., XXI, n. s., 1881, p. 48.

Occurs only at Station H. 4502.

Family LITUOLIDÆ.

Subfamily LITUOLINÆ.

Genus REOPHAX.

REOPHAX FUSIFORMIS (Williamson).

Proteonina fusiformis WILLIAMSON, Recent Foram. Gl. Britain, 1858, p. 1, pl. I, fig. 1.

Considered by Professor Brady to be a starved shallow-water variety of *Reophax scorpiurius*. Found in arctic and cold temperate zones and with sporadic occurrence in the Tropics at moderate depths down to 1,443 fathoms. Found at Station H. 4585.

REOPHAX NODULOSA Brady.

Reophax nodulosa BRADY, Quart. Journ. Microsc. Sci., XIX, n. s., 1879, p. 52, pl. IV, figs. 7, 8.

Cosmopolitan in area and bathymetric range. Found at Station H. 4585.

REOPHAX SCORPIURIUS Montfort.

Reophax scorpiurius MONTFORT, Conchyl. Syst., I, 1808, p. 330, 83d genre.

This species has a universal distribution and bathymetric range. Its geological history goes back to the Oolite. Found at Stations H. 4508, H. 4567, and H. 4694, but not very common at any of the three.

Genus HAPLOPHRAGMIUM.

HAPLOPHRAGMIUM AGGLUTINANS (d'Orbigny).

Spirolina agglutinans D'ORBIGNY, Foram. Foss. Vien., 1846, p. 137, pl. VII, figs. 10-12.

A cosmopolitan species and with correspondingly wide distribution in depth. Obtained only from Station D. 4174.

HAPLOPHRAGMIUM CANARIENSE (d'Orbigny).

Nonionina canariensis D'ORBIGNY, Foram. Canaries, 1839, p. 128, pl. II, figs. 33, 34.

Known from all oceans and at all depths. Found as a fossil but not earlier than the Pleistocene. Specimens obtained at Stations H. 4566 and H. 4696 are rather more symmetrical and possess more chambers than some of the figured types of the species. The arenaaceous test, rounded periphery, depressed umbilici, and complanate character of the chambers are sufficient to distinguish this from allied forms.

HAPLOPHRAGMIUM GLOBIGERINIFORME (Parker and Jones).

Lituola nautiloidea globigeriniformis PARKER and JONES, Phil. Trans., CLV, 1865, p. 407, pl. xv, figs. 46, 47.

This species is described with some doubt. There are only a few specimens, from Station 4585, which appear to belong here. They do not possess so many Globigerina-like segments and these are not so distinct, but the growth appears trochoid and the forms are conditionally placed here. Essentially a deep-water foraminifer of universal distribution.

HAPLOPHRAGMIUM LATIDORSATUM (Bornemann).

Nonionina latidorsata BORNEMANN, Zeitschr. deutsch. geol. Gesell., VII, 1855, p. 339, pl. XVI, figs. 4, *a*, *b*.

So abundant in the north deep sea explored by G. O. Sars that it is said to constitute one-fifth of the entire weight of the dredged material. While of universal distribution and more abundant in deep water, the form is also present in depths of 300 fathoms or less.

Known in the European Tertiary. In our dredgings this form, with *Haplophragmium scitulum*, is the most common species of the genus and was found at Stations H. 4502, H. 4566, H. 4567, and H. 4696.

HAPLOPHRAGMIUM NANUM Brady.

Haplophragmium nanum BRADY, Quart. Journ. Microsc. Sci., XXI, n. s., 1881, p. 50.

Somewhat similar to *H. canariense*, but with the segments more distinct and lobulated, and in its inequilateral development only upon the upper surface are all the segments visible. Recorded in the *Challenger* report as characteristic of cold northern and southern latitudes and at depths of from about 50 to near 2,000 fathoms. Found only at Station H. 4694.

HAPLOPHRAGMIUM SCITULUM Brady.

Haplophragmium scitulum BRADY, Quart. Journ. Microsc. Sci., XXI, n. s., 1881, p. 50.

Test closely involute, nautiloid with depressed umbilici, arenaceous dark-brown test and rough exterior. Segments numerous, narrow, straight, but slightly depressed septa. Forms somewhat resembling *Cyclammina cancellata* occur at Station 4508 and the septal lines are not quite so regular as in the type-specimens. This species is closely related to *H. latidorsatum*, which is, however, less symmetrical, and has a thicker, coarser test and a more lobulated margin.

Eleven localities for this species are reported in the *Challenger* records, eight of which were in the North Atlantic, 530 to 1,445 fathoms, one in the South Atlantic, one in the South Pacific, and one from very deep water in the North Pacific. Present at Stations H. 4430, H. 4508, H. 4585, and H. 4696. Doctor Flint mentions it from the west coast of Cuba and the west coast of Patagonia, 93 to 541 fathoms.

Genus CRITHIONINA.

CRITHIONINA PISUM var. HISPIDA Flint.

Crithionina pisum var. *hispida* FLINT, Recent Foraminifera, 1899, p. 267, pl. VI, fig. 2.

The genus *Crithionina* was established recently by A. Goes and made to include minute Foraminifera, which are largely constructed of sponge spicules and exceedingly fine gray arenaceous matter, and with a labyrinthic or cavernous, more or less spherical, chamber. This is undivided and the aperture is indistinct and divided. The hispid variety is even smaller than *Crithionina pisum* and is easily distinguished by its spinous sponge-spicule surface. There is apparently no visible aperture.

Recorded by Dr. J. M. Flint from Georges Bank, Gulf of Mexico, and coast of Oregon, at depths of from 93 to 1,813 fathoms. Found at Stations H. 4440 and H. 4502.

Genus HAPLOSTICHE.

HAPLOSTICHE SOLDANII (Jones and Parker).

Lituola soldanii JONES and PARKER, Quart. Journ. Geol. Soc., XVI, No. 184, 1860, p. 307.

Test stoutly built, nodosarian-like and of arenaceous coarse material. The internal subdivisions of the chambers do not appear on the surface. Without sectioning the aperture is the only means of distinguishing this species from *Clavulina cylindrica*, as stated under the description of that species.

This is the only living representative of the genus and is best developed in the warm waters of the West Indies at shoal depths. It is also found in the Gulf of Mexico, 196 and 210 fathoms (Flint), and around many islands of the Pacific. It is variously recorded in the European Tertiary. We find it only at Stations D. 4000 and H. 4590.

Subfamily TROCHAMMININÆ.

Genus TROCHAMMINA.

TROCHAMMINA LITUIFORMIS Brady.

Trochammina lituiformis BRADY, Quart. Journ. Microsc. Sci., XIX, n. s., 1879, p. 59, pl. v, fig. 16.

Previously recorded at only three stations in the Atlantic Ocean. An example of this species present at Station D. 4000.

TROCHAMMINA PAUCILOCULATA Brady.

Trochammina pauciloculata BRADY, Quart. Journ. Microsc. Sci., XIX, n. s., 1879, p. 58, pl. v, figs. 13, 14.

Of wide areal distribution, this species is more typically developed in deep water, often below 1,000 fathoms. Found at Station H. 4502, 1,302 fathoms; Station H. 4555, 1,398 fathoms; Station H. 4585, 689 fathoms, and Station H. 4590, 978 fathoms.

TROCHAMMINA PROTEUS Karrer.

Trochammina proteus (part) KARRER, Sitzungsber. Akad. Wiss. Wien, 1866, p. 494, pl. I, fig. 8.

Four localities furnished specimens of this species in the *Challenger* expedition, at depths varying from 390 to 2,350 fathoms. Fossil in the middle Tertiary. Found at Station H. 4566, rare; depth 572 fathoms.

TROCHAMMINA RINGENS Brady.

Trochammina ringens BRADY, Quart. Journ. Microsc. Sci., XIX, n. s., 1879, p. 57, pl. v, figs. 12, a, b.

Test nautiloid, biconvex, depressed, and composed of but few chambers, usually about one-half the number of those present in *Trochammina trusillata*. It is much more rare than the latter species, is of a dark gray or brown color, and there is no punctation of the inner surface of the shell. Not before recorded beyond the Atlantic Ocean, and said to occur at depths of from 1,675 to 2,750 fathoms. Found at Station H. 4590, 978 fathoms, rare.

Genus WEBBINA.

WEBBINA CLAVATA Jones and Parker.

Trochammina irregularis clavata JONES and PARKER, Quart. Journ. Geol. Soc., XVI, 1860, p. 304.

This adherent species was later described under the genus *Webbina*.^a The latter is always adherent on its lower surface without a definite body wall inclosing the surface of attachment, while in *Trochammina* the tube is complete and walled on all sides. The species is of wide areal distribution and of almost unlimited bathymetric range. Several examples were found at Stations D. 4000, D. 4174, H. 4476, H. 4566, H. 4590, and H. 4696.

Subfamily LOFUSINÆ.

Genus CYCLAMMINA.

CYCLAMMINA CANCELLATA Brady.

Cyclammina cancellata BRADY, in NORMAN, Proc. Roy. Soc., XXV, 1876, p. 214.

The genus *Cyclammina*, established by Brady in 1876, includes the entirely arenaceous, large, compressed, convoluted Foraminifera whose walls are finely cancellated. These are often so highly developed that the inner portion of the chambers is greatly reduced. Externally the surface is smooth and the aperture either a series of pores on the septal face or an arched fissure at the inner margin of the final segment. The periphery in *C. cancellata* is rounded. I have identified this species in the New Jersey Miocene but am not aware of its further occurrence in the fossil state. In existing oceans it is of very great bathymetric range (75 to 2,900 fathoms) and has a wide geographical distribution. It is present at Stations D. 4174 and H. 4508, at the latter with *Haplophragmium scitulum*, which the above somewhat resembles.

^a Jones, Parker, and Brady, Monograph. Foram. Craig, 1866, p. 26.
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Family TEXTULARIIDÆ.

Subfamily TEXTULARIINÆ.

Genus TEXTULARIA.

TEXTULARIA AGGLUTINANS d'Orbigny.

Tertularia agglutinans D'ORBIGNY, Foram. Cuba, 1839, p. 136, pl. 1, figs. 17, 18, 32 to 34.

A cosmopolitan foraminifer known at all depths and in every ocean. An arenaceous type becoming much elongated in the coral reefs of the tropics and treated as a variety, *T. agglutinans porrecta*, in the *Challenger* report. Found at Stations D. 4000, D. 4017, D. 4025, and H. 4502. Not abundant.

TEXTULARIA ASPERA Brady.

Tertularia aspera BRADY, Proc. Roy. Soc. Edin., XI, 1882, p. 715.

This species was established by Brady to include very coarsely arenaceous dark colored *Tertularia* characterized by oblong, compressed form composed of few segments. Obtained by the *Challenger* from five stations in the North Atlantic, 390 to 530 fathoms; three in the South Atlantic, 350 to 1435 fathoms; and two in the South Pacific, 175 and 210 fathoms. Found at Station D. 4000, depth 104 to 213 fathoms.

TEXTULARIA FOLIUM Parker and Jones.

Tertularia folium PARKER and JONES, Phil. Trans., CLV, 1865, pp. 370, 420, pl. XVIII, fig. 19.

The depths recorded in the *Challenger* report for this species vary from shore sand at Melbourne to 255 fathoms off the Fiji Islands. Our specimen comes from Station D. 4017, at a depth of 305 fathoms. The species is not known in the fossil state, and its present distribution is apparently quite restricted.

TEXTULARIA GRAMEN d'Orbigny.

Tertularia gramen D'ORBIGNY, Foram. Foss. Vien., 1846, p. 248, pl. xv, figs. 4 to 6.

Distribution cosmopolitan, but occurrence more frequent in shallow waters. Fossil in the Cretaceous and later horizons. Not abundant at Stations D. 4017, D. 4025, H. 4508, H. 4566, H. 4571, H. 4694, and H. 4696.

TEXTULARIA QUADRILATERA Schwager.

Textularia quadrilatera SCHWAGER, Novara-Exped., Geol. Theil, II, 1886, p. 253, pl. vii, fig. 103.

Test, long, slender, compressed, tapering, generally acuminate and quadrilateral. Typical specimens come from Tahiti at 420 fathoms, but the form is known also from a small number of localities in the South Atlantic and Pacific oceans. This form is rare at Stations H. 4430 and H. 4568; depths 1,544 and 1,274 fathoms, respectively.

TEXTULARIA RUGOSA (Reuss).

Plecanium rugosum REUSS, Sitzungsber. Akad. Wiss., Wien, LIX, 1869, p. 453, pl. i, figs. 3, a, b.

This coral-reef species makes its first appearance in the Oligocene. Occurs at Station H. 4568 only.

TEXTULARIA SAGITTULA DeFrance.

Textularia sagittula DEFANCE, Dict. Sci. Nat., XXXII, 1821, p. 177, LIII, p. 344; Atlas Conch., pl. XIII, fig. 5.

One of the most abundant of all the *Textularia* whether recent or fossil, and while chiefly affecting shallow waters of temperate seas is known at depths of near 2,700 fathoms. Not rare at Stations D. 4025, H. 4430, H. 4694, and H. 4696.

TEXTULARIA SIPHONIFERA Brady.

Textularia siphonifera BRADY, Quart. Journ. Microsc. Sci., XXI, n. s., 1881, p. 53.

Previously recorded from the Honolulu coral reefs, 40 fathoms, and at a few other stations of the Pacific at depths of less than 50 fathoms. Station H. 4567, at 1,307 fathoms.

TEXTULARIA TROCHUS d'Orbigny.

Textularia trochus D'ORBIGNY, Mem. Soc. Geol. France, IV, 1840, p. 45, pl. iv, figs. 25, 26.

Distribution, universal. Fossil from the Cretaceous. Occurs only at Station D. 4000.

Genus VERNEUILINA.

VERNEUILINA PROPINQUA Brady.

Verneuilina propinqua BRADY, Chal. Rept., IX, 1884, p. 387, pl. XLVII, figs. 8-14.

At five stations where this species was dredged by the *Challenger* in the North Atlantic the depths with but one exception were between 1,000 and 2,435 fathoms. Similarly three stations in the

Pacific were in depths of 95, 2,050, and 2,900 fathoms respectively. The species is therefore a deep-water form. It is not known as a fossil. Rare at Station H. 4567, depth 1,307 fathoms.

VERNEUILINA SPINULOSA Reuss.

Verneuilina spinulosa REUSS, Denkschr. Akad. Wiss. Wien, I, 1849, p. 347 pl. XLVII, figs. 12 a-c.

This species, known first from the Cretaceous chalk, is best developed in tropical and subtropical shallow waters. Its bathymetric range, however, is from a few fathoms down to 2,300. Examples of this interesting foraminifer were at Stations D. 4017, D. 4025, H. 4508, H. 4694, and H. 4696.

Genus BIGENERINA.

BIGENERINA ARENACEA Bagge, new species.

Test very large, sometimes measuring nearly an eighth of an inch in length, strongly compressed and complanate, built of coarse arenaceous and glauconitic material of a prevailing gray color.

The segments are at first biserial, later nodosarian. There are four or five of these uniserial segments and they comprise about one-half the shell in length. The test is symmetrically developed with nearly straight even sides obtusely rounded and with the aboral end broadly rounded, the entire form resembling in a general way *Bigenerina pennatula* (Batsch), but lacking the angular keeled margin and also being somewhat more compressed. The segmentation is regular, much more regular than in *Bigeneria capreolus* (d'Orbigny), and in the uniserial portion is as symmetrical as in typical *Frondicularia* types. The chambers are narrow and even, separated by broad thick slightly raised septa which are curved or arched upward at the center and at the oral end form a wedge-shaped extremity. The aperture is a median, oval, and narrow slit. The best specimens of this large arenaceous species were from stations between D. 3900 and D. 4000. (See Plate V, figs. 4-6.)

The type is Cat. No. 8196, U.S.N.M., from hydrographic Station 4508, *Albatross*. I also recognize the species at Stations D. 4174 and H. 4566.

Genus PAVONINA.

PAVONINA FLABELLIFORMIS d'Orbigny.

Pavonina flabelliformis D'ORBIGNY, Ann. Sci. Nat., VII, No. 1, 1826, p. 260, pl. x, figs. 10, 11, modèle No. 56.

Pavonina is an interesting unusual genus represented by a single species. The early chambers are small and textularian and later become uniserial and unfolded, forming a fan-like test. The aperture

is porous. This beautiful form is an inhabitant of rather shallow water and has been obtained in the West Indies, Torres Strait, Malay Archipelago, Mauritius, Ceylon, Admiralty Islands, Cocos Island, coast of Korea, and the Honolulu coral reefs. Found only at Station D. 4174. Not known in the fossil condition.

Genus GAUDRYINA.

GAUDRYINA FILIFORMIS Berthelin.

Gaudryina filiformis BERTHELIN, Mem. Soc. Geol. France, ser. 3, I, No. 5, 1880, p. 25, pl. 1, fig. 8.

With its limited number of triserial segments and its long textularian development, the above species might easily be mistaken for one of the Textularia. It was dredged by the *Challenger* at four stations at moderate depths and from both Atlantic and Pacific oceans. The fossil forms described by Berthelin were from the Gault of northern France. Not common at Station H. 4568.

GAUDRYINA PUPOIDES d'Orbigny.

Gaudryina pupoides D'ORBIGNY, Mem. Soc. Geol. France, IV, 1840, p. 44, pl. IV, figs. 22-24.

This common deep-water variety is a frequent Cretaceous fossil and is not rare in some Eocene and later Tertiary deposits. Found at Stations H. 4430, H. 4555, H. 4568, and H. 4571.

GAUDRYINA QUADRANGULARIS Bagg, new species.

The test is very large, measuring about one-eighth inch in length, sharply tapering to a trihedral distal end. The oral extremity is quadrangular in outline, resulting from compression upon two sides, and this compression does not correspond with any of the triangular portion below. The shell substance is unusually coarse and the surface very rough. The oral end is abruptly truncated and is sunken in the center to the straight slit-like aperture somewhat protected by a marginal thickening and slightly notched. (See Plate V, fig. 1.)

The type is Cat. No. 8198, U.S.N.M., Station D. 4000. It is rare.

Genus CLAVULINA.

CLAVULINA ANGULARIS d'Orbigny.

Clavulina angularis D'ORBIGNY, Ann. Sci. Nat., VII, No. 2, 1826, p. 268, pl. XII, fig. 7.

Test long, nodosarian, triangular with arched septal depressions. The triserial portion of the test is confined to the lowest portion of the shell and does not much enlarge the distal end as in *Clavulina*

parisiensis. Limited to shore sands and off-shore deposits in both Atlantic and Pacific oceans. Known from the lower Tertiary deposits of Europe. Identified in material obtained at Station D. 4017.

CLAVULINA CYLINDRICA Hantken.

Clavulina cylindrica HANTKEN, Mittheil. Jahrb. ung. geol. Anstalt, IV, 1875, p. 18, pl. I, fig. 8.

With *Haplostiche soldanii*, which it resembles, this species is found in the coral sands of tropical waters. The two are separable by their difference in aperture, *Clavulina cylindrica* always having a valvular opening, while the other is always simple or perforate. Abundant in the *Clavulina-szaboi* strata of Hungary and also from the Tertiary of Italy. Rather rare in the South Atlantic, less so in the North Atlantic, and variously recorded in shoal waters of the South Pacific. Rare in the *Globigerina* ooze of Station D. 4000.

Subfamily BULIMININÆ.

Genus BULIMINA.

BULIMINA AFFINIS d'Orbigny.

Bulimina affinis D'ORBIGNY, Foram. Cuba, 1839, p. 109, pl. II, figs. 25, 26.

Equivalent probably to Reuss's *Bulimina ovulum*, described in Cretaceous deposits and present in the North and South Pacific oceans of to-day. It is separated from *B. ovata*, which it closely resembles, only by its acute apical aboral extremity. Some specimens obtained from Stations D. 4017, D. 4025, and D. 4174.

D'Orbigny obtained his types from the shore sands of Cuba. Distribution much more limited, however, than that of the types of *B. ovata* and *B. pupoides*, which it resembles.

BULIMINA ACULEATA d'Orbigny.

Bulimina aculeata D'ORBIGNY, Ann. Sci. Nat., VII, No. 7, 1826, p. 269.

With the smooth upper portion of the test and the lower rough spinous portion, the above is one of the peculiar surface ornamentation forms found among the Buliminæ. The spines often project from the edges of the chambers as in *B. marginata*, but in the former they are never lengthened into spines.

Abundant in the North Atlantic and South Pacific and its bathymetric range extends from shallow depths down to 2,740 fathoms.

It has been recognized in the glacial clays of Norway. Present at Station H. 4567 only.

BULIMINA BUCHIANA d'Orbigny.

Bulimina buchiana D'ORBIGNY, Foram. Foss. Vien. Basin, 1846, p. 186, pl. XI, figs. 15-18.

Test triserial, short, strongly built, with well-defined ribs which extend to the lower margin of the ultimate chamber. Said to affect moderately deep water; Professor Brady reports it as abundant in the North Atlantic, rare in the South Atlantic, and common in the South Pacific. Not recorded from the North Pacific. Ranges from less than 100 down to over 2,000 fathoms. Occurs at Station II. 4568, where it is not rare, and at Station II. 4585.

BULIMINA CONTRARIA (Reuss).

Rotalina contraria REUSS, Zeitschr. deutsch. geol. Gesell., III, 1851, p. 76, pl. v, fig. 37.

It is no wonder that this little form has been described under various genera—such as *Ataxophragmium*, *Pulvinulina*, and *Cassidulinina*—for it possesses marked similarity of growth to all the above. It has, however, been rightly placed among the *Bulimina*, and its aperture alone justifies this as well as its buliminine method of growth.

Most common in shoal waters of the South Pacific, but also known in the North Pacific and the North Atlantic. Present at Stations D. 4000, H. 4430, and II. 4555. Described among the fossil Foraminifera of the Oligocene (Septaria clay) of Hemsdorf and the Miocene of Kostej, in the Banat.

BULIMINA INFLATA Seguenza.

Bulimina ovata D'ORBIGNY, Foram. Foss. Vien., 1846, p. 185, pl. XI, figs. p. 107, pl. I, fig. 10.

An intermediate type between the costate *Bulimina buchiana* and the spinous *B. aculeata* and having a distribution similar to the former, but less common. It is widely distributed in the South Pacific and is present in waters of from less than 100 to over 2,400 fathoms. We note this form from four stations, namely, II. 4566, II. 4567, H. 4568, and II. 4571. Reported in the Septaria clays of Germany and the later Tertiary of Italy.

BULIMINA OVATA d'Orbigny.

Bulimina ovata D'ORBIGNY, Foram. Foss. Vien., 1846, p. 185, pl. XI, figs. 13, 14.

Bulimina ovata, *B. affinis*, and *B. pupoides* belong to one closely related group distinguishable by such minor features as length and outline of the test, and in the relief of the chambers forming the

spire. These forms are widely distributed in existing oceans and *B. ovata* is common in shallow waters of the British coast. It is present in waters of the Pacific at depths ranging from a few up to 580 fathoms. Its geological history begins with the Eocene. Obtained at Stations D. 4017, D. 4025, H. 4508, and H. 4568.

BULIMINA PUPOIDES d'Orbigny.

Bulimina pupoides D'ORBIGNY, Foram. Foss. Vien., 1846, p. 185, pl. XI, figs. 11, 12.

Similar to above, but with more inflation and separation of segments. With its congeners it is frequently described from the Tertiary beds of Europe and its present distribution is cosmopolitan. Found at Stations D. 4025 and H. 4174.

BULIMINA WILLIAMSONIANA Brady.

Bulimina williamsoniana BRADY, Quart. Journ. Microsc. Sci., XXI, n. s., 1881, p. 56.

The tests of *Bulimina williamsoniana* is a cylindrical twisted spire with strong costae running the entire length of the shell. The anterior end is obliquely truncated and the aperture central. Limited to shoal South Pacific waters. Found at Station H. 4694 only.

Genus VIRGULINA.

VIRGULINA SQUAMOSA d'Orbigny.

Virgulina squamosa D'ORBIGNY, Ann. Sci. Nat., VII, No. 1, 1826, p. 267, modele No. 64.

Not rare in the North Atlantic; found in the South Atlantic more rarely; also in the North and South Pacific and in the Red Sea and Mediterranean. It is frequently with the related species *Virgulina subsquamosa*. Ranges in depth from 30 to 3,000 fathoms. Found at Stations D. 4025, H. 4430, H. 4555, H. 4566, H. 4568, H. 4571, H. 4585, and H. 4696, and in the *Albatross* dredging much more abundantly than *Virgulina subsquamosa*.

VIRGULINA SUBSQUAMOSA Egger.

Virgulina subsquamosa EGGER, Neues Jahrb. fur Miner., 1857, p. 295, pl. XII, figs. 19-21.

While frequently occurring with the preceding, this species is best known at depths ranging from 345 to 620 fathoms. Found less commonly than the preceding at Stations D. 4025, H. 4430, H. 4440, H. 4555, H. 4566, H. 4568, and H. 4590.

VIRGULINA SQUAMOSA STRIATA Bagg, new subspecies.

Similar to the well-known species *Virgulina squamosa*, but distinctly striated. (See Plate V, fig. 7.)

Type.—Cat. No. 8202, U.S.N.M., Station D. 4025, depth 275 to 368 fathoms.

Genus BOLIVINA.

BOLIVINA ÆNARIENSIS (Costa).

Brizalina anariensis COSTA, Atti dell' Accad. Pontin., VII, 1856, p. 297, pl. xv, figs. 1, *a*, *b*.

This neatly tapering, striate *Bolivina*, with or without its spinous aboral end, is cosmopolitan, and we found it at Stations D. 4174, H. 4440, H. 4502, H. 4508, H. 4555, H. 4567, H. 4571, H. 4585, and H. 4696.

Best developed types come from the North Atlantic Ocean at depths of a few fathoms down to 1,630 fathoms. Professor Brady records the species from off the Philippines at 95 fathoms, off the south coast of Japan at 15 fathoms, and the La Plata River, South America, at 13 fathoms. It occurs as a fossil in the Tertiary beds of the island of Ischia.

BOLIVINA DILATATA Reuss.

Bolivina dilatata REUSS, Denkschr. Akad. Wiss. Wien, I, 1849, p. 381, pl. XLVIII, fig. 15.

The test of *Bolivina dilatata* is broad, depressed, composed of numerous long narrow chambers and possessing an acute periphery.

Prof. H. B. Brady states that the species is confined to the North Atlantic, but we find it present, and in some cases abundant, at nearly every station studied. These are: D. 4017, D. 4025, D. 4174, H. 4430, H. 4502, H. 4508, H. 4555, H. 4568, H. 4571, H. 4694, and H. 4696. The average depth is below 400 fathoms. The geological occurrence dates from the Cretaceous.

BOLIVINA HANTKENIANA Brady.

Bolivina hantkeniana BRADY, Quart. Journ. Microsc. Sci., XXI, n. s., 1881, p. 58.

Test depressed and nearly equally convex on each surface, consisting of numerous broad inflated segments arranged alternately and provided at their margin with a delicate keel. The surface is usually faintly striate. Probably limited in distribution to islands of the Pacific. Present at Station D. 4017, fine specimens at H. 4440, also found at H. 4555 and H. 4585. The depths at which the form is recorded vary from 130 to 800 fathoms. Not recorded as a fossil.

BOLIVINA KARRERIANA Brady.

Bolivina karreriana BRADY, Quart. Journ. Microsc. Sci., XXI, n. s., 1881, p. 58.

This interesting little species is said to be abundant in the waters south of Japan, and it is not uncommon in the South Pacific. Found only at Station H. 4567, where it was quite rare.

BOLIVINA LIMBATA Brady.

Bolivina limbata BRADY, Quart. Journ. Microsc. Sci., XXI, n. s., 1881, p. 57.

"The twisted varieties of *Bolivina* with nearly even margins and limbate sutures, on which this species has been founded, affect the comparatively shallow water of tropical seas. They are abundant south of the island of Papua, occurring at almost every station in its immediate vicinity at which the depth does not exceed 200 fathoms. The same forms occur off the Sandwich Islands, 40 fathoms; in Hongkong Harbor, 7 fathoms; on the south shores of Japan, 15 fathoms; off the Fiji Islands, 12 fathoms; on the Australian coral reefs, 14 to 17 fathoms; in the shore sands of Madagascar; off Ascension Island, 7 fathoms; and off the Cape de Verde Islands, 11 fathoms."^a

The *Albatross* obtained this foraminifer at Station H. 4694 only.

BOLIVINA NOBILIS Hantken.

Bolivina nobilis HANTKEN, Mittheil. Jahr. ung. geol. Anstalt., IV, 1875, p. 65, pl. xv, figs. 4 *a*, *b*.

Perhaps confined to the South Pacific and to depths of less than 40 fathoms. Occurs at Stations H. 4567, H. 4696.

BOLIVINA PLICATA d'Orbigny.

Bolivina plicata D'ORBIGNY, Foram. Amer. Merid., 1839, p. 62, pl. VIII, figs. 4-7.

Test moderately compressed, with sinuous or, as it were, plicate septal lines, rough surface, as if arenaceous, pores not very distinct, and shell opaque in transmitted light. Well figured by Goes.^b Found only at Station H. 4567.

BOLIVINA PUNCTATA d'Orbigny.

Bolivina punctata D'ORBIGNY, Foram. Amer. Merid., 1839, p. 61, pl. VIII, figs. 10-12.

This well-known cosmopolitan form is present at every station except H. 4000, H. 4430, H. 4776, H. 4555, H. 4571, H. 4579, and H. 4590. In some instances, as at Station D. 4025, it is abundant.

^a Brady, Chal. Rept., IX, p. 419.

^b Arctic and Scand. Foram., 1894, p. 51, pl. IX, figs. 487, 488.

BOLIVINA ROBUSTA Brady.

Bolivina robusta BRADY, Quart. Journ. Microsc. Sci., XXI, n. s., 1881, p. 57.

Thirteen of the twenty-two localities given in the *Challenger* report, where the above species is found, were in the South Pacific. Abundant at some stations and present at D. 4025, H. 4555, H. 4566, H. 4568, H. 4571, and H. 4585. The species is generally confined to shallow waters, but in one instance it was obtained at 1,900 fathoms in the South Atlantic.

A. Goes considers this form only a variety of *B. dilatata*, but I believe it should be regarded as a distinct species.

BOLIVINA SEMI-ALATA Bagg, new species.

The nearest approach to this Foraminifer of which the writer has knowledge is *Bolivina hantkeniana*. The forms we have, however, are extremely narrow and stoutly built, with numerous chambers extending to nearly one-half the length of the shell. The ultimate chambers are exceedingly broadly expanded and widely keeled, the flange extending even over and around the aperture. The lower end is acuminate. Two of these types were observed at Station H. 4555. The shell is large for the genus *Bolivina*. (See Plate V, fig. 3.)

Type.—Cat. No. 8197, U.S.N.M., Station H. 4555.

BOLIVINA TEXTILARIOIDES Reuss.

Bolivina textilarioides REUSS, Sitzungsber. Akad. Wiss. Wien, XLVI, 1862, p. 81, pl. x, fig. 1.

More important from the fossil standpoint than any *Bolivina* unless perhaps *B. punctata*, and widely represented in existing seas. Its bathymetric range is also very extensive, but it is best developed on shallow bottoms. It is one of the best known Cretaceous *Bolivinas*. Found at Stations H. 4017, fine examples at H. 4025, also present at H. 4430, H. 4440, H. 4508, H. 4566, H. 4568, H. 4585, H. 4694, and H. 4696.

Subfamily CASSIDULININÆ.

Genus CASSIDULINA.

CASSIDULINA CRASSA d'Orbigny.

Cassidulina crassa D'ORBIGNY, For. Amer. Merid., 1839, p. 56, pl. VII, figs. 18-20.

Synonymous with *Cassidulina oblonga* Reuss. Characterized by its obtuse periphery, oval outline, and small number of short inflated segments, which distinguishes the species from *C. laevigata*.

Common over wide areas in the North Atlantic and at depths as great as 2,760 fathoms. A long list of localities given by Professor

Brady in the *Challenger* report includes numerous localities in the North and South Pacific and the South Atlantic, and the form is present in the Mediterranean. Its geological history dates from the Miocene. Found by the *Albatross* at Stations H. 4440 and H. 4694.

CASSIDULINA SUBGLOBOSA Brady.

Cassidulina subglobosa BRADY, Quart. Journ. Microsc. Sci., XXI, n. s., 1881, p. 60.

"Test subglobular, somewhat compressed on the two lateral faces, inequilateral; segments few, slightly inflated; alternation irregular. Aperture an oblique or nearly erect loop-like slit on the face of the projecting terminal segment."^a Essentially a deep-water species, the above is known from all the large oceans, but the localities are not very numerous. Found at three *Albatross* stations, namely, H. 4430, H. 4571, and H. 4585.

Genus EHRENBURGINA.

EHRENBURGINA SERRATA Reuss.

Ehrenburgina serrata REUSS, Denkschrift, Akad. Wiss. Wien, I, 1849, p. 377, pl. XLVIII, figs. 7 a-c.

The genus *Ehrenburgina* is closely related to *Cassidulina*, but differs in the arrangement of the biserial chambers and less inrolled growth. *Cassidulina* has the segments both biserial and convolute, and resembles a bolivine shell longitudinally folded and then rolled in this suture from end to end and possessing a bulimine aperture. The typical species of *Ehrenburgina* are longer than *Cassidulina* and the margins are frequently serrate or spinous.

Living representatives of the genus belong to southern oceans, and the bathymetric range is from several to over 2,000 fathoms. This species is well known from the Miocene. We find it rather abundant at several stations—H. 4430, H. 4476 (common), H. 4567, H. 4694, and H. 4696.

Family LAGENIDÆ.

Subfamily LAGENINÆ.

Genus LAGENA.

LAGENA FAVOSO-PUNCTATA Brady.

Lagena favoso-punctata BRADY, Quart. Journ. Microsc. Sci., XXI, n. s., 1881, p. 62.

Previously reported from the shores of New Guinea. Rare at Stations H. 4590 and H. 4694.

^a Brady, Chal. Rept., IX, p. 430.

LAGENA GLOBOSA (Montagu).

Vermiculium globosum MONTAGU, Test. Britain, 1803, p. 523.

This cosmopolitan species of to-day has a long geological record, dating possibly from the Carboniferous, but certainly from the Oolite. Found only at Station H. 4567.

LAGENA HISPIDA Reuss.

Lagena hispida REUSS, Zeitschr. deutsch. Geol. Gesell., X, 1858, p. 434.

The test of *Lagena hispida* varies in shape, but always shows a hispid surface, which is its distinguishing characteristic. Like the preceding, this species has a long geological history, dating from the Lias. In recent waters it is not limited in distribution or depth, but it is not abundant wherever found. Present at Station H. 4585.

LAGENA LÆVIS (Montagu).

Vermiculium laeve MONTAGU, Test. Britain, 1803, p. 524.

One of the simplest unornamented unicellular hyaline Foraminifera. On account of its variability in form it has been described under many names, a long list of which is given in any complete synonymy of the species. It is unquestionably one of the earliest Foraminifera known, occurring in Upper Silurian deposits. Its distribution and bathymetric range are unlimited at the present time. Obtained only at Station H. 4585.

LAGENA LAGENOIDES (Williamson).

Entosolenia marginata lagenoides WILLIAMSON, Recent Foram. Gt. Britain, 1858, p. 11, pl. I, figs. 25, 26.

Test oval elongate, compressed and bordered by a decorated keel which surrounds the entire shell. *Lagena formosa* Schwager has a wider similarly striated margin but the distal portion is notched and wing-like. Found in comparatively shoal waters in the South Pacific (38 to 410 fathoms), and of rather wide geographical distribution elsewhere and at greater depths. Most frequent in the Atlantic. Known in the Miocene of Sicily (Seguenza). Obtained from *Albatross* Station H. 4566 only.

LAGENA MARGINATA (Walker and Boys).

Serpula marginata WALKER and BOYS, Test. Min., 1784, p. 2, pl. I, fig. 7.

The above broadly oval, smooth-shelled *Lagena* is distinguished from other forms by its peripheral margin which is extended into a wide keel. Universally known in every ocean and at every depth,

its geological history dating from the chalk beds of the Cretaceous. Present most commonly of all the *Lagena* noted at Stations D. 4017, D. 4174, H. 4430, and H. 4696.

LAGENA QUADRATA (Williamson).

Eutrosolenia marginata quadrata WILLIAMSON, Recent Foram. Gt. Britain, 1858, p. 11, pl. i, figs. 27, 28.

Present in various localities in both Atlantic and Pacific, but always at depths of less than 150 fathoms. Known in the Miocene of Italy and the Post-Tertiary of Ireland. Occurs at *Albatross* Stations H. 4440 and H. 4694.

LAGENA STRIATA (d'Orbigny).

Oolina striata D'ORBIGNY, Foram. Amer. Merid., 1839, p. 21, pl. v, fig. 12.

An oval, frequently bottle-shaped *Lagena* with elongated tubular neck and striate surface. Of world-wide distribution the form is found equally with *Lagena sulcata*, which it resembles, but the species belongs to shallow waters. It is present in the *Septaria* clays of Germany and in the Miocene elsewhere. Noted at three stations, H. 4566, H. 4567, and H. 4694.

Subfamily **NODOSARIINÆ.**

Genus **NODOSARIA.**

NODOSARIA CALOMORPHA Reuss.

Nodosaria calomorpha REUSS, Denkschr. Akad. Wiss. Wien, XXV, 1865, p. 129, pl. i, figs. 15-19.

One of the simplest smooth *Nodosaria* and of only two or three segments. North and South Atlantic, South Pacific, and elsewhere in off-shore deposits at less than 100 fathoms. Reported, however, at depths of over 2,000 fathoms. Fossil in the *Septaria* clay of North Germany. Station H. 4508, rare.

NODOSARIA COMMUNIS (d'Orbigny).

Dentalina communis D'ORBIGNY, Mem. Soc. Geol. France, IV, 1840, p. 13, pl. i, fig. 4.

Smooth surface, oblique septa, and slender build are the three leading characteristics of the species. The synonymy as at present understood and published in monographs on Foraminifera is very extensive. As a recent Foraminifer it has a universal distribution. Its geological history dates from the beginning of the Mesozoic. The most common nodosarian in the material examined, and present at Stations D. 4000, D. 4025, H. 4430, and H. 4566. The specimens obtained are most excellent representatives.

NODOSARIA CONSOBRINA var. EMACIATA Reuss.

Dentalina emaciata REUSS, Zeitschr. deutsch. Geol. Gesell., III, 1851, p. 63, pl. III, fig. 9.

Professor Brady records the above variety of the typical *N. consobrina* at depths of from 290 to 725 fathoms in the North Atlantic and 350 fathoms in the South Atlantic; in the South Pacific from 129 to 1,375 fathoms. Found in the Cretaceous chalk and subsequent formations. Occurs at Station D, 4000 only.

NODOSARIA GUTTIFERA (d'Orbigny).

Dentalina guttifera D'ORBIGNY, Foram. Foss. Vien., 1846, p. 49, pl. II, figs. 11-14.

This species must not be confounded with *Nodosaria guttifera* (Parker and Jones), which is unquestionably to be regarded as *Nodosaria soluta*. In the form figured by d'Orbigny in the Vienna Basin memoir the segments of *Nodosaria guttifera* are gracefully oval, bulbous at base and connected to the next succeeding chamber by a very slender neck. In *Nodosaria soluta* the segments are smooth and the distal chamber usually mucronate, but the segments are more closely joined and the sutures are not as deeply depressed or constricted as in *Nodosaria guttifera*. Fragments only at Station H, 4566.

NODOSARIA LÆVIGATA (d'Orbigny).

Glandulina laevigata D'ORBIGNY, Ann. Sci. Nat., VII, 1826, p. 252, pl. x, figs. 1-3.

There appear to be three well-defined types of *Nodosaria* belonging to the *Glandulina* type, best represented by *Nodosaria laevigata* with its sharp distal and generally mucronate and its relatively large development of the ultimate chamber; second, the form *Nodosaria rotundata*, with its more bluntly rounded nonspinous primordial margin and slightly greater elongation of the chambers; and third, *Nodosaria aequalis*, with its still greater elongation and wider segments. Some of the specimens we find in the three stations, D, 4025, H, 4555, and H, 4696, are not distinctly mucronate but they are decidedly pointed at the distal end and may better be considered as varieties of this exceedingly varied species.

The relationship of the various types belonging to this group are well described by Professor Reuss in his paper on Von Schlicht's drawings of Tertiary Foraminifera.^a The distribution of the species is world-wide. Its bathymetric range is generally less than 1,000 fathoms.

^a Sitzungsber. Akad. Wiss. Wien, LXII, p. 478.

NODOSARIA PAUPERATA (d'Orbigny).

Dentalina pauperata D'ORBIGNY, Foram. Foss. Vien., 1846, p. 46, pl. 1, figs. 57, 58.

Geographic and bathymetric range unlimited. Fossil from Lias to Recent. Stations D. 4000 and D. 4025.

NODOSARIA ROEMERI (Neugeboren).

Dentalina roemeri NEUGEBOREN, Denkschr. Akad. Wiss. Wien, XII, 1856, p. 82, pl. II, figs. 13-17.

Occurs at Station H. 4566 only. More common in the North Atlantic at depths of less than 400 fathoms. Fossil from Cretaceous (lower) to Recent.

NODOSARIA SCALARIS (Batsch).

Nautilus scalaris BATSCH, Conchyl. des Seesandes, No. 4, 1791, pl. II, figs. 4, a, b.

Distribution and range in depth not limited, but the form is more frequent in shoal water. A well-known Tertiary fossil. Occurs only at Station H. 4566.

NODOSARIA SOLUTA Reuss.

Dentalina (Nodosaria) soluta REUSS, Zeitschr. deutsch. Geol. Gesell., III, 1851, p. 60, pl. III, figs. 4, a, b.

Occurs at moderate depths but preferably in shallow waters in many localities. It is recorded as a fossil in the Cretaceous. Present at Station H. 4964, but not common.

NODOSARIA VERTEBRALIS (Batsch).

Nautilus vertebralis BATSCH, Conchyl. des Seesandes, No. 6, 1791, p. 3, pl. II, figs. 6, a, b.

Distribution mostly confined to the North Atlantic and South Pacific at depths of less than 500 fathoms. We have recorded the species from the New Jersey Cretaceous. It is, however, more common in the Tertiary. Found at Station D. 4000 only.

Genus LINGULINA.

LINGULINA CARINATA d'Orbigny.

Lingulina carinata D'ORBIGNY, Ann. Sci. Nat., VII, No. 1, 1826, p. 257, modele No. 26.

The noncostate variety of this species appears to be rare and was obtained by the *Challenger* expedition at only three stations, off Ki Islands, 580 fathoms, off the Honolulu coral reefs, 40 fathoms, and off Nightingale Island, 100 to 150 fathoms. Reported as a fossil from the English Lias. Rare at Station H. 4508.

Genus FRONDICULARIA.

FRONDICULARIA ROBUSTA Brady.

Frondicularia robusta BRADY, Chal. Rept., IX, p. 523, pl. LXVI, figs. 1, 2.

This is the only species of the genus *Frondicularia* noted in the stations dredged and it is rare at Station 4508. Professor Brady observed it at only two localities, one near Ki Islands, 129 fathoms, the other on the coral reefs of the Hawaiian Islands, 40 fathoms. The form is characterized by its robust test, with surface strongly costate, but less regularly so than in *Nodosaria*.

Genus RHABDOGONIUM.

RHABDOGONIUM MINUTUM Reuss.

Rhabdogonium minutum REUSS, Sitzungsber. Akad. Wiss. Wien, LV, 1867, p. 84, pl. v, figs. 4, 5.

The only specimens of this species dredged by the *Challenger* came from off Ki Islands at a depth of 129 fathoms. The form was noted rather frequently at Stations D. 4000, H. 4430, H. 4508, H. 4555, H. 4695, and H. 4696.

RHABDOGONIUM TRICARINATUM (d'Orbigny).

Vaginulina tricarinatum D'ORBIGNY, Ann. Sci. Nat., VII, No. 4, 1826, p. 258, modele, No. 4.

Rhabdogonium tricarinatum has a wide distribution in the fossil world and is frequently recorded in Tertiary strata. A variety of this form (*acutangulum*) is known in the Lower Cretaceous. In living condition the form is met with in the North Atlantic from shoal water down to over 1,300 fathoms. It comes also from the Mediterranean and the Pacific, and is very abundant in the *Albatross* dredgings, being found in all stations except H. 4476, H. 4502, H. 4567, H. 4579, and H. 4590.

Genus VAGINULINA.

VAGINULINA LEGUMEN (Linnaeus).

Nautilus legumen LINNÆUS, Syst. Nat., 10th ed., 1758, p. 711; 12th ed., 1767, p. 1164.

A cosmopolitan form with universal distribution and at all depths found sparingly. Has a long geological history and is known at least as early as the Trias. In later formations it becomes more frequent and I have recorded it from the New Jersey Cretaceous, where it is by no means rare. Found at Stations D. 4174 and 4567.

Genus CRISTELLARIA.

CRISTELLARIA ARTICULATA Reuss.

Cristellaria articulata REUSS, Sitzungsab. Akad. Wiss. Wien, XLVIII, 1863, p. 53, pl. v, fig. 62.

This species was described by Reuss in 1870 under the genus *Cristellaria*, although he had previously placed it under the genus *Robulina*, a name now in disuse. The shell is stoutly built, thicker and with more angular margin than *Cristellaria rotulata*. There is also a smaller number of segments in typical specimens.

"Fine examples of *Cristellaria articulata* occur in the dredged sands from off Culebra Island, 390 fathoms, and off Nightingale Island, Tristan da Cunha, 100 to 150 fathoms. In the latter locality the species is very abundant, and what is more remarkable the species assume wild-growing forms, such as are represented by figs. 1-4, pl. LXIX."^a Found by the writer in the New Jersey Cretaceous and variously recorded in Tertiary deposits. *Cristellaria* are not abundant in any of the material we have here studied, but there are as many species represented as there are occurrences. We find this species typically developed at Station H. 4696.

CRISTELLARIA CALCAR (Linnæus).

Nautilus calcar LINNÆUS, Syst. Nat., 12th ed., No. 272, p. 1162; 1788, Syst. Nat., 13th (Gmelin's) ed., No. 2, p. 3370.

As now used the species designated as *Cristellaria calcar* comprises those smooth-shelled involute nautiloid types with a spinous periphery. The spinous and flange-like border is exceedingly variable. Of cosmopolitan distribution at moderate depths. Geologically recorded in the Tertiary. Present at Station D. 4000.

CRISTELLARIA CREPIDULA (Fichtel and Moll).

Nautilus crepidula FICHTEL and MOLL, Test. Microsc., 1803, p. 107, pl. XIX, figs. g-i.

The above may well serve as the type of complanate elongate-oval *Cristellaria* with segments at first involute and later drawn out and separated by straight septa. The periphery is not carinate, although thin and round. A shallow water form and more frequent in temperate than in tropical seas. It has a long geological history and has been described by the author from the Cretaceous marl of Vincentown, New Jersey. It is the most common species of the genus in the 19 bottles of *Albatross* dredgings. Occurs at Stations D. 4000, H. 4430, H. 4508, and H. 4694.

^a Brady, Chal. Rept., IX, p. 547.

CRISTELLARIA CULTRATA (Montfort).

Robulus cultratus MONTFORT, Conchyl. Syst., 1, 1808, p. 214, 54 genre.

Distinguished from *Cristellaria rotulata* by its carinate border. Occurs with the latter less frequently but is usually in somewhat deeper water. Cretaceous to Recent. Present at Stations D, 4000, H, 4566, and H, 4696.

CRISTELLARIA ELEGANTISSIMA (Costa).

Robulina elegantissima COSTA, Pal. Napoli, 2, 1854, p. 198, pl. XIX, fig. 4.

Compare ref. in GOES, Kongl., Svenska, Vetenskaps Akad. Handl. XXV, No. 9, p. 64.

I think I am right in ascribing to the above species the form described below. The test is much compressed and rather strongly striate with smooth ultimate chamber slightly prolonged. The outline is quadrangular and the periphery bluntly rounded without keel. There are about seven chambers visible in the last convolution, the inner ones but faintly visible, the latter clearly marked by the slightly depressed septa. The aperture is fissurine, somewhat prolonged but not tubular. The shell we find of a grayish-white color and large for the genus. In general growth the test strongly resembles *Cristellaria crepidula*, but it is more stoutly built, and there is a difference in the method of extension of the chambers forming the last convolution. There is a figured form of *Cristellaria* in Professor Williamson's Monograph on the Recent Foraminifera of Great Britain which roughly resembles the present form (fig. 55, pl. 11), but the latter is provided with a well-defined flange. Present at Station H, 4508 of the *Albatross*.

Our one specimen is comparable to the figured specimen of A. Goes.^a

CRISTELLARIA GIBBA d'Orbigny.

Cristellaria gibba D'ORBIGNY, Foramin. Cuba, 1839, p. 63, pl. VII, figs. 20, 21.

"Sublenticular, equally biconvex, smooth, characterized by the somewhat inflated and protuberant final segment, and its contracted septal face."^b

Cosmopolitan, but usually at depths of less than 500 fathoms. Cretaceous to Recent. Found at Stations D, 4000 and H, 4694, but not common.

^a Arctic and Scand. Recent Foramin., p. 64, pl. XI, fig. 642 b.

^b Flint, Recent Foramin., p. 317.

CRISTELLARIA ORBICULARIS (d'Orbigny).

Robulina orbicularis D'ORBIGNY, Ann. Sci. Nat., VII, 1826, p. 288, pl. xv, figs. 8, 9.

Differs from *Cristellaria vortex* in its flange, or keeled border. West Indies, 450 fathoms, numerous localities in the South Pacific, and fossils in the Sub-Apennine of Italy and the Vienna Basin Miocene. Rare at Station H. 4508.

CRISTELLARIA ROTULATA (Lamarck).

Lenticulites rotulata LAMARCK, Annales du Mus., V, 1804, no. 3, p. 188; Tab. Encycl. et Method. pl. CCCCLXVI, fig. 5.

This species is the type of the group and is probably the most generally distributed and at greater variety of depths than any form of the genus. Its geological history is also long and dates from the Upper Trias of Derbyshire, England. Not uncommon at Station D. 4000 and present at H. 4430.

CRISTELLARIA VORTEX (Fichtel and Moll).

Nautilus vortex FICHTEL and MOLL, Test. Microsc., 1803, p. 33, pl. II, figs. d-i.

Chambers very long and narrow and separated by exceedingly curved septa, which sweep backwards a long portion of the shell. Test moderately vaulted and umbonate. Mentioned by Brady from four stations in the South Pacific, 125 to 420 fathoms, and off Bermuda, in North Atlantic, 435 fathoms. Parker and Jones record the species in the Mediterranean, 90 to 360 fathoms. Flint mentions it from the Caribbean. Observed only at Station H. 4508. It is known as a Tertiary fossil.

Subfamily POLYMORPHININÆ.

Genus POLYMORPHINA.

POLYMORPHINA AMYGDALOIDES Reuss.

Polymorphina amygdaloides REUSS, Sitzungsber. Akad. Wiss. Wien, XVIII, 1855, p. 250, pl. VIII, fig. 84.

A depressed variety of the more common species *Polymorphina lactea*. Occurs rarely at Stations D. 4017, D. 4174, and H. 4567.

POLYMORPHINA ANGUSTA (Egger).

Globulina angusta EGGER, Neues Jahrb. für Miner., 1857, p. 290, pl. XIII, figs. 13-15.

We find what appears to be a variety of the above species at Station 4017. The form is of wide distribution, and while known in shallow dredgings is usually found at considerable depths. Fossil in the Bavarian Miocene.

POLYMORPHINA COMMUNIS (d'Orbigny).

Guttulina communis d'ORBIGNY, Ann. Sci. Nat., VII, 1826, p. 266, pl. XII, figs. 1-4, modele No. 62.

Occurs at Station 4585 only of the *Albatross* cruise, but is of universal distribution, with almost unlimited bathymetrical range, and is fossil in the early Mesozoic (Lower Lias), becoming more common in Cretaceous strata and succeeding formations.

POLYMORPHINA COMPRESSA d'Orbigny.

Polymorphina compressa d'ORBIGNY, Foram. Foss. Vien., 1846, p. 233, pl. XII, figs. 32-34.

Cosmopolitan. Fossil in the English Lias. Stations D. 1017, H. 4430, and H. 4694 but not common.

POLYMORPHINA GIBBA (d'Orbigny).

Globulina gibba d'ORBIGNY, Ann. Sci. Nat., VII, No. 20, 1826, p. 266, modele No. 63.

Test almost globular with three chambers visible on one of the surfaces and flush suture lines. Occurring first in the Oolite, this form is known in many succeeding formations and has a wide distribution in existing oceans. Found at Station H. 4430 only, and rare.

POLYMORPHINA LACTEA (Walker and Jacob).

Serpula lactea WALKER and JACOB (according to Kammacher), Adam's Essays, 1798, 2d ed., p. 634, pl. XXIV, fig. 4.

One of the most widely known forms of the genus in both fossil and living condition and occurring as early as the Jurassic. Found at Station H. 4579.

POLYMORPHINA OBLONGA d'Orbigny.

Polymorphina oblonga d'ORBIGNY, Foram. Foss. Vien., 1846, p. 232, pl. XII, figs. 29-31.

More restricted in its distribution than *Polymorphina lactea* and generally at depths of less than 500 fathoms. Found at Station H. 4694 only.

POLYMORPHINA REGINA Brady, Parker, and Jones.

Polymorphina regina BRADY, PARKER, and JONES, Trans. Linn. Soc. London, XXVII, 1870, p. 241, pl. XLI, figs. 32, a, b.

This is one of the few *Polymorphinae* with surface ornamentation. The costae are regular and equidistant. The original specimens were from Storm Bay, Tasmania. The other localities are in shallow water in the tropics. A less regular costate form occurs in the Cre-

taceous, and has been described under the name *Polymorphina semicostata* Marsson. *P. regina* was found at Station H. 4694, but was rare.

Genus UVIGERINA.

UVIGERINA ANGULOSA Williamson.

Uvigerina angulosa WILLIAMSON, Recent Foram. Gt. Britain, 1858, p. 67, pl. v, fig. 140.

This small foraminifer we find quite abundantly at many stations. It is reported to be very widely distributed and at depths from 50 to 1,630 fathoms. Found at Stations D. 4000, D. 4017, D. 4174, H. 4440, H. 4502, H. 4508, H. 4567, H. 4568, H. 4571, and H. 4694.

UVIGERINA ASPERULA Czjzek.

Uvigerina asperula CZAZEK, Haidinger's Nat. Abhandl., II, 1847, p. 146, pl. XIII, figs. 14, 15.

Rather widely distributed in nearly all oceans and at depths varying from a few fathoms down to over 2,000. Known as a fossil in the Baden Miocene. A very abundant form in nearly every *Albatross* station, and absent at Stations D. 4000, D. 4017, D. 4174, H. 4476, H. 4579, and H. 4696 only.

UVIGERINA ASPERULA var. AMPULLACEA Brady.

Uvigerina asperula var. *ampullacea* BRADY, Chal. Rept., IX, 1884, p. 579, pl. LXXV, figs. 10, 11.

The average depth for this species is not far from 500 fathoms. Not so common as the preceding, but rather abundant in many localities. Found at Stations D. 4174, H. 4440, H. 4508, H. 4555, H. 4566, H. 4567, H. 4568, H. 4571, and H. 4694.

UVIGERINA ASPERULA var. AUBERIANA d'Orbigny.

Uvigerina auberiana D'ORBIGNY, Foram. Cuba, 1839, p. 110, pl. II, figs. 23, 24.

Less abundant than the typical species, the *Challenger* specimens were obtained at depths of 580 fathoms, Ki Islands; 610 fathoms, off Kandava; and 630 fathoms, Rockhall Bank, and from shore sands of the West Indies. The variety is not rare at several stations of the *Albatross*, but is not quite so well represented as the variety *ampullacea* and still less than *Uvigerina asperula*. It occurs at Stations D. 4174, H. 4508, H. 4566, H. 4567, H. 4568, and H. 4571.

UVIGERINA CANARIENSIS d'Orbigny.

Uvigerina canariensis D'ORBIGNY, Foram. Canaries, 1839, p. 138, pl. I, figs. 25-27.

The distribution of this species is somewhat peculiar. It is known from very shoal waters as well as from depths of nearly 2,000 fathoms. Found at Stations D. 4000, D. 4025, and H. 4571.

UVIGERINA CANARIENSIS var. STRIATA Bagg, new subspecies.

Notwithstanding that Professor Brady has mentioned the fact that some forms of *Uvigerina canariensis* are very weakly striated in their lower portion and that such forms are synonymous with d'Orbigny's *Uvigerina arnaldi*, I find at Station 4566 a form which has definite striations extending in groups clear and well-defined, though not closely set down, and over the last chamber as well as over the earlier segments as in *Uvigerina pygmaea*. The inflation of the segments is marked and the septa are depressed. This form seems to be sufficiently marked to be considered distinct, although Professor Brady has treated such specimens as varieties only of the more widespread type, *Uvigerina canariensis*. (See Plate V, fig. 2.)

Type.—Cat. No. 8201, U.S.N.M.

UVIGERINA INTERRUPTA Brady.

Uvigerina interrupta BRADY, Quart. Journ. Microsc. Sci., XIX, n. s., 1879, p. 60, pl. VIII, figs. 17-18.

The original specimens of this species came from a few localities in the South Pacific, at depths varying from 37 down to 1,375 fathoms. Present but not very common at Stations H. 4430, H. 4440, and H. 4508.

UVIGERINA PYGMÆA d'Orbigny.

Uvigerina pygmaea D'ORBIGNY, Ann. Sci. Nat., VII, 1826, p. 269, pl. XII, figs. 8, 9, modele No. 67.

This is a widely distributed form both recent and in the Tertiary fossil beds, and its bathymetric range in existing oceans appears to be practically unlimited. It is not at all common in the *Albatross* material, but we find examples at Stations H. 4502, H. 4508, H. 4571, H. 4694, and H. 4696.

UVIGERINA TENUISTRIATA Reuss.

Uvigerina tenuistriata REUSS, Sitzungsber. Akad. Wiss. Wien, LXII, 1870, p. 485.—VON SCHLICHT, Foram. Pietzpuhl, 1870, pl. XXII, figs. 34-36.

Reported from off the Philippines in 95 fathoms, off Heard Island, 75 fathoms, and off Raine Island, 155 fathoms; also off coast of Patagonia, 140 fathoms. Not common at Stations D. 4017, H. 4476, H. 4585, and H. 4696.

Genus SAGRINA (SAGRINA).

SAGRINA COLUMELLARIS Brady.

Sagrina columellaris BRADY, Quart. Journ. Microsc. Sci., XXI, n. s., 1881, p. 64.

The name of this genus is by some authors spelled *Sagraina* after Reuss, although *Sagrina* appears to be also in use. This handsome

species is larger than *Sagraina dimorpha*, the segments are smooth with the sutures flush, and the walls are not prominently perforated. It has been recorded at a limited number of localities in the Atlantic and Pacific in both shallow and deep waters. Rather common at Stations D. 4000, D. 4017, D. 4025, II. 4430, II. 4508, II. 4585, and II. 4694.

SAGRAINA DIMORPHA Parker and Jones.

Uvigerina (Sagraina) dimorpha PARKER and JONES, Phil. Trans., CLV, 1865, p. 420, pl. XVIII, fig. 18.

A cosmopolitan species at moderate depths and more abundant than other species of the genus. Occurs at stations II. 4440, II. 4566, and II. 4694.

SAGRAINA IRREGULARIS Bagg. new species.

Test elongate with irregularly set stout segments separated by septa which are but little depressed, giving a nodosarian aspect to the shell. The distal end is narrowly rounded without being acuminate, the anterior abruptly truncated with an invaginated siphonal tube at the end of which is the circular flaring aperture. This peculiar inset effect of the apertural tube, together with the irregularly set chambers, affords a ready means of separation of the form from *Sagraina striata* Schwager, which the species somewhat resembles. The striations of the surface are sinuous, delicate and fairly persistent, but they branch in some places. The texture of the shell is fine semitranslucent hyaline calcareous matter and the tests are rather large and well built for the genus. Found in material from Stations D. 4025 and II. 4571 and common at the former station. (See Plate V, figs. 8-10.)

Type.—Cat. No. 8200, U.S.N.M., Station 4025.

Family GLOBIGERINIDÆ.

Genus GLOBIGERINA.

GLOBIGERINA ÆQUILATERALIS Brady.

Globigerina æquilateralis BRADY, Quart. Journ. Microsc. Sci., XIX, n. 8, 1879, p. 71.

This symmetrically but loosely built *Globigerina* is one of the most abundant forms in all the material dredged in the 19 stations we examined. The forms are large and beautiful and in various stages of growth. This is less common perhaps than *Globigerina bulloides*, but is of larger size. Not likely to be confused with *G. cretacea*, which is more involute, trochoid in its growth, and less common. Present in surface waters only of both the North and South Pacific; in bottom material also in the South Atlantic. Geological range, Cretaceous (?) to Recent. Abundant at every station except II. 4579, where it is apparently absent.

GLOBIGERINA BULLOIDES d'Orbigny.

Globigerina bulloides d'ORBIGNY, Ann. Sci. Nat., VII, 1826, No. 1, p. 277, modele No. 17 and (young) No. 76.

The most abundant form in Recent oceans at all latitudes and at all depths, constituting the bulk of *Globigerina* oozes. A very common fossil from the Cretaceous through the Tertiary. Abundant at every locality of the 19 stations here described.

GLOBIGERINA BULLOIDES var. TRILOBA Reuss.

Globigerina triloba REUSS, Denkschrift. Akad. Wiss. Wien, I, 1849, p. 374, pl. XLVII, figs. 11 *a-c*.

Regarded as only an unimportant variety of *G. bulloides*, always associated with the latter, but less common. This form was found at six stations only—D. 4174, H. 4502, H. 4508, H. 4566, H. 4567, and H. 4568—although it is probably present in others where *Globigerinae* are abundant.

GLOBIGERINA CONGLOBATA Brady.

Globigerina conglobata BRADY, Quart. Journ. Micr. Sci., XIX, n. s., 1879, p. 72.

Equally abundant, with other *Globigerina* types, in every dredging except D. 4000, H. 4440, H. 4508, and H. 4579.

Common in surface collections in the great oceans, but most frequent in warmer latitudes and in the Tropics. Professor Brady in the *Challenger* report limits it to latitude 40° north and 35° south in the Atlantic, and a still more restricted area in the Pacific. Not recorded in the fossil world.

GLOBIGERINA CRETACEA d'Orbigny.

Globigerina cretacea d'ORBIGNY, Mém. Soc. Géol. France, IV, 1840, p. 34, pl. III, figs. 12-14.

There can be no doubt but that this widely distributed Cretaceous foraminifer is still living in existing seas. The test closely resembles *G. dubia* Egger, but is more complanate. Abundant in Cretaceous chalk beds of both Europe and America. Present in the Caribbean Sea at 500 meters (Goes).^a Observed at Stations H. 4502, H. 4566, and H. 4567, but not very abundant.

GLOBIGERINA DIGITATA Brady.

Globigerina digitata BRADY, Quart. Journ. Micr. Sci., XIX, n. s., 1879, p. 72.

The great elongation of one, two, or even three final chambers into digit-like tubes from a small closely set body whorl are the remark-

^a Alex. Goës, Ret. Rhizop. carib. sea, Kongl. Svenska Vetenskaps—Akad. Handlingar, XIX, p. 4, pl. VI, figs. 204-206.

able characteristics of this *Globigerina*. Professor Brady does not mention it as a pelagic organism and believes its distribution to be very limited. Found rather frequently at some stations and present at H. 4174, H. 4440, 4585, H. 4566, H. 4571, H. 4585, H. 4590, and H. 4694.

GLOBIGERINA DUBIA Egger.

Globigerina dubia EGGER, Neues Jahrbuch für Min., 1857, p. 281, pl. ix, figs. 7-9.

"The *Globigerina dubia* of Egger can only be accepted as a varietal modification of *Globigerina bulloides*, representing perhaps the best development of the typical characters. The test attains somewhat larger dimensions, is stout and compactly built, distinctly rotaline in general conformation, and with a well-marked umbilical cavity. It has frequently as many as fourteen or fifteen segments. Pelagic specimens of this variety have been taken in the South Atlantic and in the North and South Pacific; and in bottom ooze it has been found also in the North Atlantic. Its northern limit appears to be about latitude 56'' north, a little to the south of the Rockhall Bank; whilst in the opposite hemisphere it reaches as far as about latitude 46° south in the Southern Ocean."^a Doctor Egger's fossils were from the Miocene of Bavaria. Obtained at Stations D. 4174, H. 4430, H. 4502, H. 4508, H. 4555, H. 4566, H. 4568, and H. 4571.

GLOBIGERINA HELICINA d'Orbigny.

Globigerina helicina D'ORBIGNY, Ann. Sci. Nat., VII, 1826, No. 5, p. 277.

Reported to be rare in both the North and South Atlantic and the South Pacific. Known as a fossil in the Italian Tertiary. Rare and found only at Station H. 4696.

GLOBIGERINA RUBRA d'Orbigny.

Globigerina rubra D'ORBIGNY, Foram. Cuba, 1839, p. 94, pl. iv, figs. 12-14.

Most abundant in Tropical oceans. Rather less common in our material than other *Globigerina* and found at all stations save D. 4000, H. 4440, H. 4508, H. 4555, H. 4571, and H. 4590.

GLOBIGERINA SACCULIFERA Brady.

Globigerina sacculifera BRADY, Geol. Mag., Dec. 11, IV, 1877, p. 535.

Next to *Globigerina bulloides* this is the most abundant species of the genus *Globigerina* in our material, and we find it very plentiful and present in every station except H. 4585. Its range is similar to that of *G. conglobata*.

^a Brady, Chal. Rept., IX, pp. 595-596.

Genus ORBULINA.

ORBULINA UNIVERSA d'Orbigny.

Orbulina universa D'ORBIGNY, Foram. Cuba, 1839, p. 3, pl. I, fig. 1.

One of the most wide-spread Foraminifera in existing oceans and of unlimited bathymetric range. Fossil in the Lias and later formations. Abundant in every *Albatross* station examined.

Genus PULLENIA.

PULLENIA OBLIQUILOCULATA Parker and Jones.

Pullenia obliquiloculata PARKER and JONES (Introd. Foram. 1862, p. 183) : Phil. Trans., CLV, 1865, pp. 368, 421, pl. XIX, fig. 4.

Unknown in the fossil state, and the only representative of the genus living at the surface in mid-ocean. Occurs rather abundantly at Stations D. 4000, H. 4430, II. 4502, II. 4508, II. 4555, H. 4566, H. 4567, H. 4585, II. 4694, and II. 4696.

PULLENIA SPHÆROIDES (d'Orbigny).

Nonionina sphaeroides D'ORBIGNY, Ann. Sci. Nat., VII, No. 1, 1826, p. 293, modele No. 43.

Quite common at Stations H. 4502, II. 4508, II. 4555, H. 4566, II. 4567, II. 4568, and H. 4585. A cosmopolitan species dating back to the Cretaceous.

Genus SPHÆROIDINA.

SPHÆROIDINA BULLOIDES d'Orbigny.

Sphaeroidina bulloides D'ORBIGNY, Ann. Sci. Nat., VII, No. 1, 1826, p. 267, modele No. 65.

Of very wide geographical and bathymetrical distribution. Fossil in the European chalk. Occurs at Stations D. 4174, II. 4555, II. 4566, and H. 4567.

SPHÆROIDINA DEHISCENS Parker and Jones.

Sphaeroidina dehiscens PARKER and JONES, Phil. Trans., CLV, 1865, p. 369, pl. XIX, figs. 5, a, b.

Common in tropical waters and recorded in the Pliocene deposits of Kar Nicobar. Much more abundant in our dredgings than *S. bulloides*. Not rare and found at Stations D. 4017, H. 4430, II. 4555, H. 4566, H. 4567, H. 4571, H. 4585, and H. 4590.

Genus CANDEINA.

CANDEINA NITIDA d'Orbigny.

Candeina nitida D'ORBIGNY, Foram. Cuba, 1839, p. 111, pl. II, figs. 27, 28.

Test trochoid with globose segments, along the junction of which are a series of pores which cover in a regular manner the entire sutural depressions. Shell white and shining and resembling *Globigerina*, but the pores so minute that they can not be seen except under very high power; the shell in this respect resembling *Sphaeroidina*. The genus is represented by only this one species, and it is present both in surface and bottom material, with the thinner shell cover in the surface specimens.

Reported not rare in dredgings from Funafuti, in the South Pacific, at depths of 50 to 200 fathoms. Abundant along with *Globigerina* in every ooze we have studied, except at Stations D. 4017 and H. 4579. Not known in the fossil condition.

Family ROTALIIDÆ.

Subfamily ROTALIINÆ.

Genus CYMBALOPORA.

CYMBALOPORA POEYI (d'Orbigny).

Rosalina poeyi D'ORBIGNY, Foram. Cuba, 1839, p. 100, pl. III, figs. 18-20.

This peculiar rotaliform genus has its most typical representation in the above species. It is known in two distinct types, one high and vaulted form the other strongly depressed. The first we observe frequently in several of our dredgings, particularly at Station 4025. The species is common in tropical coral sands. Found at Stations D. 4000, D. 4017, D. 4025, H. 4476, and H. 4696. Not known in the fossil state.

DISCORBINA OBTUSA (d'Orbigny).

Rosalina obtusa D'ORBIGNY, Foram. Foss. Vien., 1846, p. 179, pl. XI, figs. 4-6.

Test plano-convex, with superior surface, but little elevated. Sutures depressed, slightly curved on the superior surface and the margin somewhat lobulated. The inferior surface shows but few chambers, with straight depressed septa reaching to the umbilicus. The striate aspect of this lower surface is not constant.

Recorded and figured by Goes from material collected near Spitzbergen at a depth of 40 meters. Parker and Jones record it as plentiful off the Hunde Islands, Davis Straits, 28 to 70 fathoms. Professor Brady reports it from off Ascension Islands, 420 fathoms.

D'Orbigny described it from the Vienna Basin Miocene at Nussdorf. *Discorbinae* are uncommon in the material we examined, and this species was present only at Station II. 4568.

DISCORBINA TURBO (d'Orbigny).

Rotalia (Trochulina) turbo D'ORBIGNY, Ann. Sci. Nat., VII, No. 29, 1826, p. 274, modele No. 73.

Cretaceous to Recent. Shoal waters, tropical oceans. Rare at Station II. 4694.

DISCORBINA VILARDEBOANA (d'Orbigny).

Rosalina vilardeboana D'ORBIGNY, Foram. Amer. Merid., 1839, p. 44, pl. VI, figs. 13-15.

Recent only. Universal distribution in existing oceans. Limited to shallow waters. Not uncommon at Stations II. 4440 and II. 4568.

Genus TRUNCATULINA.

TRUNCATULINA AKNERIANA (d'Orbigny).

Rotalina akneriana D'ORBIGNY, Foram. Foss. Vien., 1846, p. 156, pl. VIII, figs. 13-15.

Present at Station II. 4590 only.

TRUNCATULINA CULTER (Parker and Jones).

Planorbulina culter PARKER and JONES, Phil. Trans., CLV, 1865, p. 421, pl. XIX, figs. 1, a, b.

The original specimens of this species were from a depth of 1,080 fathoms in the tropical Atlantic. Found at Stations II. 4502 and II. 4567 of the *Albatross*.

TRUNCATULINA DUTEMPLEI (d'Orbigny).

Rotalina dutemplei D'ORBIGNY, Foram. Foss. Vien., 1846, p. 157, pl. VIII, figs. 19-21.

This foraminifer is apparently not uncommon in the middle European Tertiary, but is rare and at depths of over 1,000 fathoms in existing oceans. Station II. 4571, 384 fathoms, not common.

TRUNCATULINA HAIDINGERII (d'Orbigny).

Rotalina haidingerii D'ORBIGNY, Foram. Foss. Vien., 1846, p. 154, pl. VII, figs. 7-9.

Not common in existing oceans, but known in nontypical specimens at depths of from 90 to 1,776 fathoms chiefly in the South Pacific. Found in the Upper Cretaceous and best developed in the Tertiary formation. Occurs sparingly at Station II. 4508.

TRUNCATULINA LOBATULA (Walker and Jacob).

Nautilus lobatulus WALKER and JACOB, Adam's Essays, Kamnacher's ed., 1798, p. 642, pl. xiv, fig. 36.

One of the most widely diffused Rotaline types known and occurring frequently in all formations where Foraminifera are present from the Carboniferous to Recent. Found at all stations except II. 4430, H. 4502, II. 4555, II. 4566, II. 4579, II. 4585, and II. 4590.

TRUNCATULINA MUNDULA Brady, Parker, and Jones.

Truncatulina mundula BRADY, PARKER, and JONES, Trans. Zool. Soc. London, XII, Pt. 7, 1888, p. 228, pl. xlv, fig. 25.

The authors state that this form, common at 230 fathoms off the Abrohlos Bank, South America, is intermediate between *Truncatulina haidingerii* and *Truncatulina ungeriana*. It is more compressed than the former, with about double as many chambers in each convolution, and they consider *Pulvinulina karsteni* its nearest isomorph. Specimens agreeing closely with the description and figure of this species we find at Station D. 4000, depth 104 to 213 fathoms.

TRUNCATULINA PRÆCINCTA (Karrer).

Rotalia praeincta KARRER, Sitzungsber. Akad. Wiss. Wien, LVII, 1868, p. 189, pl. v, fig. 7.

Of this coral reef species no typical representatives occur in the *Albatross* collections, but what perhaps is a variety of the form occurs rarely at Station II. 4476.

TRUNCATULINA PYGMÆA Hantken.

Truncatulina pygmaea HANTKEN, Mittheil. Jahrb. ung. Geol. Anstalt, IV, 1875, p. 78, pl. x, fig. 8.

This is a very deep-water species, being found at depths of 1,570 to 3,125 fathoms. Represented at Station H. 4502, 1,342 fathoms.

TRUNCATULINA REFULGENS (Montfort).

Cibicides refulgens MONTFORT, Conch. System., I, 1808, p. 122, 31 genre.

Truncatulina refulgens occurs at depths ranging from about 50 to 2,500 fathoms and is typically represented in the temperate-zonal waters outside the Tropics. Found rather infrequently at Stations D. 4000, D. 4174, II. 4430, II. 4476, II. 4566, and H. 4696. It is a well-known fossil from the Cretaceous and later formations.

TRUNCATULINA WUELLERSTORFI (Schwager).

Anomalina wuellerstorfi SCHWAGER, Novara Exped., Geol. Theil, II, 1866, p. 258, pl. VII, figs. 105, 107.

This species is very abundant in nearly all of the *Albatross* material examined and is wanting only at Stations D. 4000, D. 4476, H. 4555, H. 4566, and H. 4579. Its earliest appearance dates back to the Cretaceous.

Genus ANOMALINA.

ANOMALINA AMMONOIDES (Reuss).

Rosalina ammonoides REUSS, Verstein. böhm. Kreid., Pt. 1, 1845, p. 36, pl. XIII, fig. 60; pl. VIII, fig. 53.

Easily recognized by its depressed involute nautiloid form with rounded margin and median aperture. The species is, however, liable to considerable minor varieties. It is chiefly found in the South Pacific, and in waters of moderate depths. As a fossil it is well known in the Cretaceous of both this country and Europe. It is not abundant in the material studied but occurs at Stations D. 4000, D. 4025, D. 4174, H. 4430, H. 4440, H. 4476, H. 4508, H. 4566, H. 4567, H. 4579, and H. 4694, and is rather common at D. 4025.

ANOMALINA ARIMINENSIS (d'Orbigny).

Planulina ariminensis D'ORBIGNY, Ann. Sci. Nat., VII, 1826, p. 280, pl. v, figs. 1-3 bis, modele No. 49.

Differs from *A. ammonoides* in the greater compression of the test and the more squarely built periphery, together with a stronger limbation of the sutures.

Widely found in the North Atlantic, at moderate depths; rare in the South Atlantic, and also the South Pacific; abundant in the Mediterranean. Found also at the Abrolhos Bank from 47 to 940 fathoms, and in Hongkong Harbor. In the fossil state it is known from the Cretaceous, and has been found in the Tertiary and later deposits in many localities. Rather rare at Stations H. 4430 and H. 4567.

ANOMALINA CORONATA Parker and Jones.

Anomalina coronata PARKER and JONES, Ann. Mag. Nat. Hist., ser. 2, XIX, 1857, p. 294, pl. X, figs. 15, 16.

The above species is coarsely constructed, like *Anomalina grosserugosa*, but the segments are more or less angular along each side of the peripheral border and sharply marked off from the depressed umbilici. The perforation of the shell is coarse and the test large. Rare within the Tropics but abundant in many temperate zone dredgings from the North and South Atlantic oceans. Geologically known from the Eocene through the later Tertiaries. It is usually found

at shoal water depths, although 1,630 fathoms have yielded specimens. We recognize the species at Stations D. 4000, H. 4566, H. 4571, and H. 4696. Perhaps the largest and most typical are from Station H. 4566.

ANOMALINA GROSSERUGOSA (Gumbel).

Truncatulina grosserugosa GUMBEL, Abhandl. d. k. bayer. Akad. Wiss., II, Cl. X, 1868, p. 660, pl. II, figs. 104, a, b.

Resembles *Anomalina ammonoides*, but is larger, more stoutly built and has only a few chambers in the last convolution. The perforation is coarse but there are fewer pores upon the superior surface.

The *Challenger* expedition obtained this form from only a few localities in the North and South Atlantic and in the North and South Pacific. The depths were from 345 to over 2,000 fathoms. I am inclined to think, however, that it is much more common than these results would indicate. I find excellent specimens at Station D. 4502 and it is present at the following localities: Stations D. 4174, H. 4430, H. 4440, H. 4502, H. 4508, H. 4555, H. 4571, and H. 4696.

I have recorded the form in the New Jersey Cretaceous and it has been variously recorded in the European Tertiary. A very similar form is found in the Vienna basin Miocene near Baden, and described by d'Orbigny under the name *Anomalina badenensis*.^a

ANOMALINA POLYMORPHA Costa.

Anomalina polymorpha COSTA, Atti dell' Accad. Pontan., VII, 1856, p. 252, pl. XXI, figs. 7-9.

A large coarsely built form with extensions of the chambers at the periphery irregularly into stout spines. The perforation is very large and the pores few, and the species is somewhat like *Anomalina grosserugosa*, but is less thick. It is considered isomorphous with *Rotalia calcar* and *Pulvinulina spinimargo*.

Present at shallow depths in both Atlantic and Pacific oceans. Recorded by Costa from the Miocene of Italy. Occurs at Stations D. 4017, H. 4476, H. 4508, H. 4568, H. 4579, H. 4590, and H. 4696.

Genus PULVINULINA.

PULVINULINA CANARIENSIS (d'Orbigny).

Rotalia canariensis D'ORBIGNY, Foram. Canaries, 1839, p. 130, pl. 1, figs. 34-36.

Not confined to the Tropics but more abundant there. In our dredgings, common but less abundant than *P. menardii*. Stations D. 4000, D. 4174, H. 4430, H. 4440, H. 4476, H. 4502, H. 4508, H. 4555, H. 4566, H. 4567, H. 4568, H. 4585, H. 4590, H. 4694, and H. 4696.

^a For. Foss. Vienna, p. 171, pl. x, figs. 1-3.

PULVINULINA CRASSA (d'Orbigny).

Rotulina crassa D'ORBIGNY, Mem. Soc. Geol. France, IV, 1840, p. 32, pl. III, figs. 6, 7.

Described in the Cretaceous but not in succeeding formations. Occurs in bottom dredgings at great depths as well as in shallower waters and over a wide area of distribution. Stations H. 4430, H. 4555, H. 4566, H. 4571, H. 4585, and H. 4590 of the *Albatross* cruise.

PULVINULINA ELEGANS (d'Orbigny).

Rotulina elegans D'ORBIGNY, Ann. Sci. Nat., VII, No. 54, 1826, p. 276.

One of the most beautiful of all *Pulvinulina* and of very large size. It is a comparatively shallow-water type, while its related form, *Pulvinulina partschiana*, is a deep-water species. Found rather abundant at Stations D. 4174, H. 4430, H. 4502, H. 4508, H. 4555, H. 4567, H. 4571, H. 4585, and H. 4696.

PULVINULINA GILBERTI Bagg, new species.

From the dredging of Station 4567 I find two specimens of *Pulvinulina* which appear to be new. The test is highly vaulted upon the inferior side, with deeply sunken septa which extend from the margin to the umbilicus in an almost straight line, as in *Pulvinulina canariensis* d'Orbigny, which this species somewhat resembles. The segments are, however, more compactly built and the aperture, a neatly shaped arch, lies midway between the periphery and the umbilicus upon the inferior surface. The superior surface, instead of being vaulted as in *P. canariensis*, is almost complanate and the periphery is almost keeled, being quite sharp and distinct, although somewhat lobulated on the last two chambers of the ultimate whorl. There are five segments visible in the last convolution and they are equally distinct upon both surfaces. (See Plate V, figs. 11-15.)

The shell is very minute and firmly built. It has a slight resemblance to *Truncatulina dutemplei* (d'Orbigny), but the margin is sharp and more angular in the present form, and the septal lines upon the inferior surface are much more depressed and the chambers more inflated. It is somewhat doubtful whether the present form should be considered a distinct species or only a variety of *Pulvinulina menardii*, which it resembles. It is much smaller than *P. menardii*, much more vaulted upon the inferior surface, and a little more closely involute. The septal depressions also are strong, deeply sunken on the lower side, and extend straight to the center. Upon the superior side they are strongly curved as in *P. menardii*. There are five of these chambers in the final convolution. The ultimate chamber is largest and in its outline reminds one of the auriculate

type of *Pulvinulina*, but it is not so extended from the whorl. It is not a young form of *P. menardii*. Present and rather common at Station II. 4555.

Named for Professor Charles H. Gilbert, of Stanford University, California.

Type.—Cat. No. 8199. U.S.N.M., Station II. 4555.

PULVINULINA MENARDII (d'Orbigny).

Rotalia menardii D'ORBIGNY, Ann. Sci. Nat., VII, No. 26, 1826, p. 273, modele No. 10.

This is the most abundant *Pulvinulina* found in the *Albatross* material, and it is typically developed and present at every station but one, II. 4579. Its geological history dates from the Cretaceous. In existing oceans the distribution is world-wide and ranging down to 2,750 fathoms or more.

PULVINULINA MENARDII var. FIMBRIATA Brady.

Pulvinulina menardii var. *fimbriata* BRADY, Chal. Rept., IX, 1884, pp. 691, 692, pl. CIII, figs. 3, *a*, *b*.

Stations II. 4567, II. 4571, and II. 4694, but not common at any of them.

PULVINULINA MICHELINIANA (d'Orbigny).

Rotalina micheliniana D'ORBIGNY, Mém. Soc. Géol. France, IV, 1840, p. 31, pl. III, figs. 1-3.

This species, while never abundant in our material, is not at all rare and in some localities it is rather plentiful. The forms are typical specimens and rather large.

Obtained at all Stations except at D. 4025, where *Pulvinulina* are not abundant, and at II. 4579.

PULVINULINA PARTSCHIANA (d'Orbigny).

Rotalina partschiana D'ORBIGNY, Foram. Foss. Vien., 1846, p. 153, pl. VII, figs. 28-30; pl. VIII, figs. 1-3.

A deep-water variety of *Pulvinulina elegans*, as stated above. Occurs only at Station II. 4568.

PULVINULINA PATAGONICA (d'Orbigny).

Rotalina patagonica D'ORBIGNY, Foram. Amer. Merid., 1839, p. 36, pl. II, figs. 6-8.

A common constituent of bottom dredgings, but rare in surface material. Present at Stations II. 4502 and II. 4566.

PULVINULINA PROCERA Brady.

Pulvinulina procera BRADY, Quart. Journ. Microsc. Sci., XXI, n. s., 1881, p. 66.

This species closely resembles *Pulvinulina schreibersii*, but the test is higher and more conical. Found only at Station H. 4508.

PULVINULINA PUNCTULATA (d'Orbigny).

Rotalia punctulata D'ORBIGNY, Ann. Sci. Nat., VII, No. 25, 1826, p. 273, modele No. 12.

Station D. 4017, but rare. Prof. H. B. Brady in the *Challenger* Report (p. 686) writes that with the exception of one occurrence near the west coast of Patagonia the species is limited to the North Atlantic, and we may be wrong in placing the few specimens we have under this species. The characters agree tolerably well, however, and the identification may be conditionally made as above.

PULVINULINA REPANDA (Fichtel and Moll).

Nautilus repandus FICHTEL and MOLL, Test. Microsc., 1803, p. 35, pl. III, figs. a-d.

We do not find good representatives of the above species in our dredgings, but the form occurs at Stations D. 4017 and H. 4694.

PULVINULINA SCHREIBERSII (d'Orbigny).

Rotalia schreibersii D'ORBIGNY, Foram. Foss. Vien., 1846, p. 154, pl. VIII, figs. 4-6.

Occurs in the Middle Tertiary. Reported from seven stations in the South Pacific. Found sparingly at Stations H. 4476 and H. 4566.

PULVINULINA MENARDII var. TUMIDA Brady.

Pulvinulina menardii var. *tumida* BRADY, Geol. Mag., IV, 1877, Dec. 11, p. 294.

Chiefly tropical and generally from bottom dredgings. Frequent at all stations, in common with *P. menardii*, except D. 4017, D. 4025, H. 4440, H. 4579, and H. 4696.

Genus ROTALIA.

ROTALIA SOLDANII (d'Orbigny).

Rotalia soldanii D'ORBIGNY, Ann. Sci. Nat., VII, No. 5, 1826, p. 278, modele No. 36.

A common species of wide distribution and most frequent at depths below 1,000 fathoms. Eocene to Recent. Rare at Stations H. 4508, H. 4555, and H. 4585.

Family NUMMULINIDÆ.

Subfamily POLYSTOMELLINÆ.

Genus NONIONINA.

NONIONINA DEPRESSULA (Walker and Jacob).

Nautilus depressulus WALKER and JACOB, Adam's Essays, Kammacher's ed., 1798, p. 641, pl. XIV, fig. 33.

Widely distributed at the present time and common in the European Tertiaries. Found at Stations D. 4025, H. 4430, H. 4440, and H. 4466.

NONIONINA ORBICULARIS Brady.

Nonionina orbicularis BRADY, Denkschr. Akad. Wiss. Wien, XLIII, 1881, p. 105, pl. II, figs. 5, *a*, *b*; Ann. Mag. Nat. Hist., ser. 5, VIII, p. 415, pl. XXI, figs. 5, *a*, *b*.

I think I am right in placing the small *Nonionina* found at Station H. 4566 in this species. The form resembles *Nonionina pompilioides* in outline, but the former has more segments, thicker umbilici, and less regular arrangement of the segments. This species has been dredged off the cold waters of Spitzbergen, off the Canaries, off Patagonia, and elsewhere, but at very shallow depths. It is obtained in the Eocene and later Tertiary of Europe. Station H. 4566.

NONIONINA POMPILIOIDES (Fichtel and Moll).

Nautilus pompilioides FICHTEL and MOLL, Test. Microsc., 1803, p. 31, pl. II, figs. *a-c*.

Test thicker and more involute than *Nonionina umbilicatula*, which this species resembles, and the septa less distinct. Reported to be less common than similar species. Chiefly confined to deep water and generally below 1000 fathoms. Fossil in the Miocene and later formations. Station H. 4567 only, and not common.

NONIONINA SCAPHA (Fichtel and Moll).

Nautilus scapha FICHTEL and MOLL, Test. Microsc., 1803, p. 105, pl. XIX, figs. *d-f*.

The elongate oval segments and depressed chambers which rapidly enlarge from the umbilicus make the form easily recognizable. Frequent in dredgings from many regions and common as a fossil in the Tertiary. It does not appear to be limited in depth. Stations D. 4000, D. 4025, H. 4440, H. 4567, and H. 4696 afford specimens of this species. It appears to be the most common *Nonionina* in our dredgings.

NONIONINA UMBILICATULA (Montagu).

Nautilus umbilicus MONTAGU, Test. Britain, 1803, p. 191; Suppl., p. 78, pl. XVIII, fig. 1.

Nonionina umbilicatulula may be regarded as occupying an intermediate position between *N. depressula* and *N. pompilioides*. It is found at all depths from a few to over 3,000 fathoms. Its geographical distribution is equally extensive. Its geological history commences with the Eocene. Occurs at Stations II. 4508 and II. 4555.

Genus POLYSTOMELLA.

POLYSTOMELLA MACELLA (Fichtel and Moll).

Nautilus macellus FICHEL and MOLL, Test. Microsc., 1803, p. 66, pl. x, figs. c-g.

A compressed variety of the more abundant type *Polystomella crispa*. Chiefly in shallow, tropical waters, but it is the earliest known fossil belonging to the genus and occurs in the Middle Jura. Found at Stations D. 4000 and II. 4430.

POLYSTOMELLA SUBNODOSA (Munster).

Robulina subnodosa MUNSTER (according to Roemer), Neues Jahrb., für Miner., 1838, p. 391, pl. III, fig. 61.

This occurs but twice in the *Challenger* dredgings, off Booby Island, and southwest of Papua at from 6 to 28 fathoms. Rare at Station II. 4508.

POLYSTOMELLA STRIATOPUNCTATA (Fichtel and Moll).

Nautilus striatopunctata FICHEL and MOLL, Test. Microsc., 1803, p. 61, pl. IX, figs. a-c.

One of the most abundant species of *Polystomella* whether recent or fossil. Depth and range unlimited. Fossil in the early Eocene. Found at Station D. 4174.

Subfamily NUMMULITINÆ.

Genus AMPHESTEGINA.

AMPHESTEGINA LESSONII d'Orbigny.

Amphistegina lessonii (part) D'ORBIGNY, Ann. Sci. Nat., VII, No. 3, 1826, p. 304, pl. XVII, figs. 1-4.

The recent types of *Amphistegina* are very difficult to separate even in varieties on account of the great variation of form they exhibit. Professor Brady^a separates the species *Amphistegina lessonii* into three divisions, namely: (1) compressed lenticular form (= *A. vulgaris* Parker, Jones, and Brady), (2) thick variety, more often in-

^a Challenger Report, IX, p. 740.

equilateral (= *A. gibbosa* Williamson), and (3) thick forms, still more inequilateral (= *A. rugosa* d'Orbigny). In the material studied there are two well-developed types; one rather small, shining, white, nearly equilateral, moderately vaulted, with all the segments visible in the final volution, the other very gibbous, opaque, larger than the first, with some granulations around the aperture near the margin, with the chambers uniformly curved, and without the sinuosity of the smaller types. It is possible that this second form represents a new type, but since so much latitude has been granted the original *A. lessonii* I prefer to consider these two types as one and refer to the average symmetrical form as *A. lessonii* and the other as the globose variety. The species is unusually abundant in the Hawaiian dredgings. It was recognized in the following stations of the 19 examined: D. 4000, D. 4025, D. 4174, II. 4430, II. 4440, II. 4476, II. 4508, II. 4566, II. 4567, II. 4579, and II. 4694. The typical globose type is abundant at Station 4476.

Abundant in the tropical waters of the great oceans. It is best developed on bottoms of less than 30 fathoms, and is rare below 400 fathoms.

Genus HETEROSTEGINA.

HETEROSTEGINA DEPRESSA d'Orbigny.

Heterostegina depressa D'ORBIGNY, Ann. Sci. Nat., VII, 1826, p. 305, pl. XVII, figs. 5-7, modele No. 99.

Like *Haplostiche*, this genus has but a single living representative. It is a shallow-water tropical form found around many coral islands. But two specimens of this well-known species were obtained at Station II. 4566.

Genus NUMMULITES.

NUMMULITES CUMINGII Carpenter.

Amphistegina cumingii CARPENTER, Phil. Trans., 1859, p. 32, pl. v, figs. 13-17.

The classification of recent *Nummulites* is to the mind of the writer in an entirely unsatisfactory condition. The difficulty has come from considering under one species many marked varieties with not only more chambering in each volution but also from a difference in vaulting or thickness of contour, which results in altering the entire figure of the shell. Under *Amphistegina* were mentioned several varieties, and the same might be done with the *Nummulites* series. The multiplication of chambers, however, is, I think, important and a form with twice the segmentation in a given whorl ought not to be regarded as belonging to a species with only one-half as many.

Again the asymmetry of the test is one of the chief features which serve to distinguish the genus *Nummulites* from *Amphistegina*, and even Carpenter later referred the present form to *Nummulites* after

previously classifying it with *Amphistegina*. However that may be, there is a considerable amount of variation among these forms which in the fossil state would be sufficient to cause their separation into several species or at least important varieties of the typical form. This matter can not be properly entered into here, but we have purposely kept *Nummulites radiata* separate from *Nummulites comingii*, notwithstanding that it is considered synonymous by Prof. H. B. Brady.

The species *Nummulites comingii* is confined to tropical and sub-tropical latitudes and is found only in very shallow waters. In specimens from Station D. 4000 there are fourteen chambers in the final convolution. In *Nummulites radiata* the number is much greater (nearly double), and they are more sinuous. Also the shell is of a dark brown color in *Nummulites radiata* and somewhat smaller. Stations D. 4000, II. 4476, II. 4566 (?), and II. 4590. Not as abundant as *Amphistegina* at any of the above stations.

NUMMULITES RADIATA d'Orbigny.

Nummulina radiata D'ORBIGNY, Foram. Foss. Vien., 1846, p. 115, pl. v, figs. 23, 24.

Test compressed, discoidal, smooth, and composed of over twenty segments in the final convolution, separated by flexed septa, somewhat irregular. Considered by d'Orbigny as related to *Nummulina lenticularis*, but with its chambers more inflected. D'Orbigny's specimens were from the Nussdorf Miocene. Two examples of this type were taken at Station II. 4476.

EXPLANATION OF PLATE V.

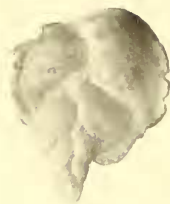
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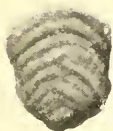
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SOME NEW SPECIES OF HAWAIIAN FORAMINIFERA.

FOR EXPLANATION OF PLATE SEE PAGE 168.

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